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May 1949

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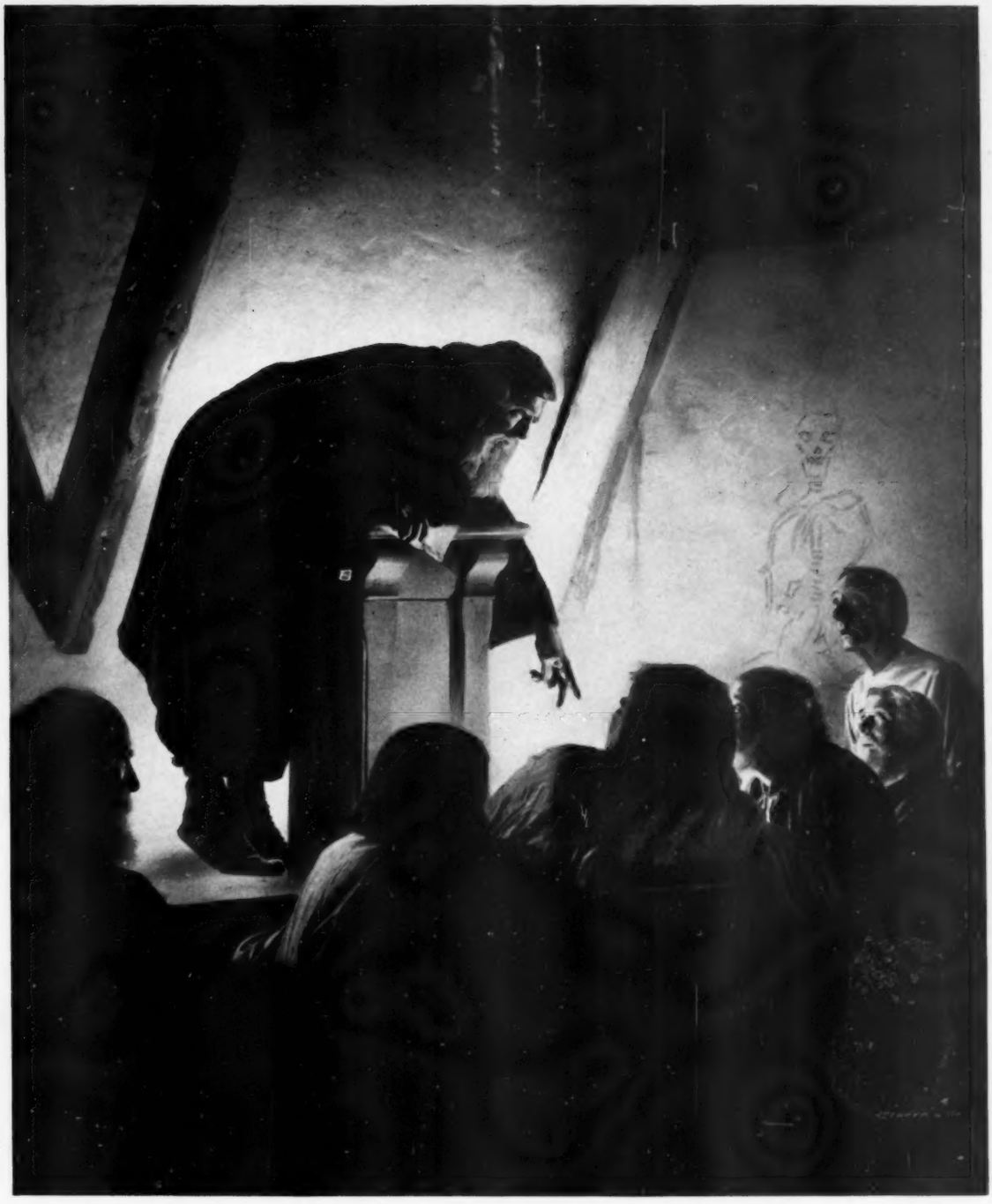
SUTURES IN ANCIENT SURGERY



Henri de Mondeville

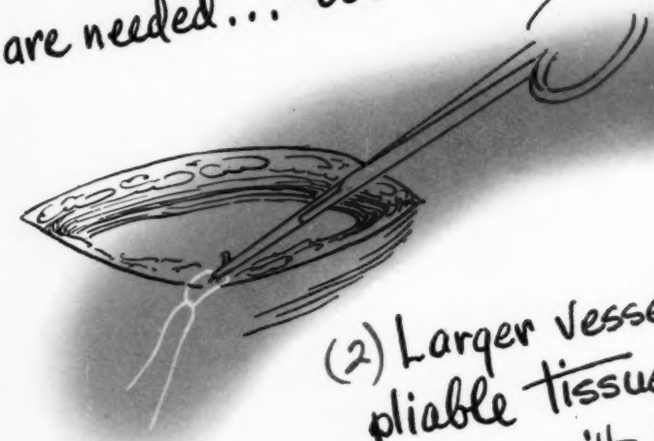
(1260-1320)

SUTUREGRAM

NUMBER THIRTEEN IN A SERIES

Sutures – Hemostasis

(1) To ligate vessels in abdominal wall only finest sizes of sutures are needed... #000 or #4-0

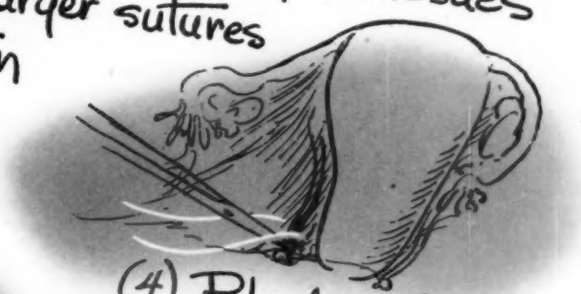


(2) Larger vessels in soft pliable tissues can be ligated with fine sutures – but should be transfixed to neighboring tissues to prevent slipping

SUTUREGRAM

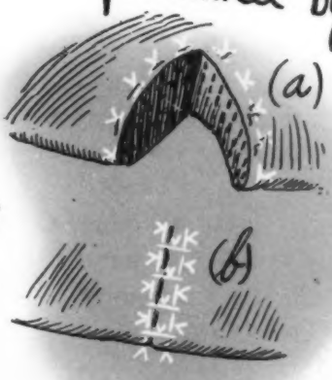
NUMBER THIRTEEN (CONTINUED)

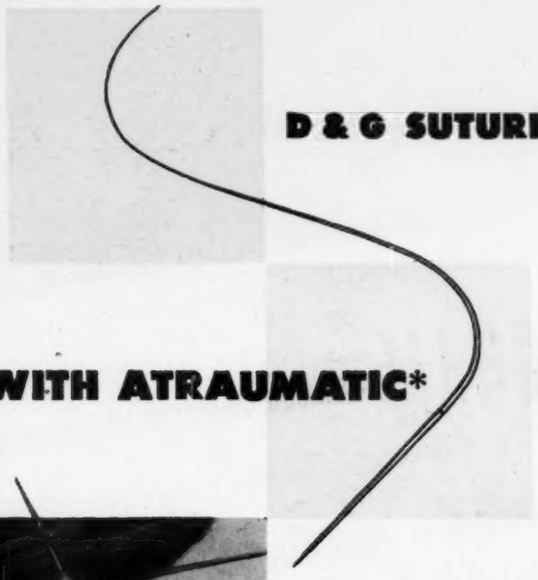
(3) Larger vessels in tough fibrous tissue or imbedded deep in tissues require larger sutures for ligation



(4) Bleeding from vessels which cannot be secured, can be stopped by figure-of-eight suture

(5) Hemorrhage from liver is prevented by placing mattress sutures on both sides of incision (a) then approximating edges with loosely tied sutures (b)





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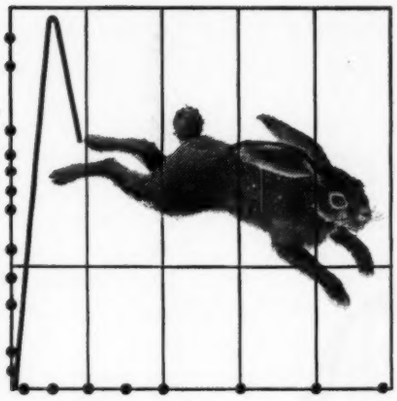

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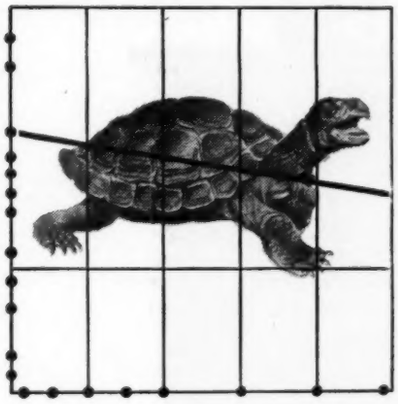

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*Thomas, E. W., et al: *J.A.M.A. 137:1517, 1948*

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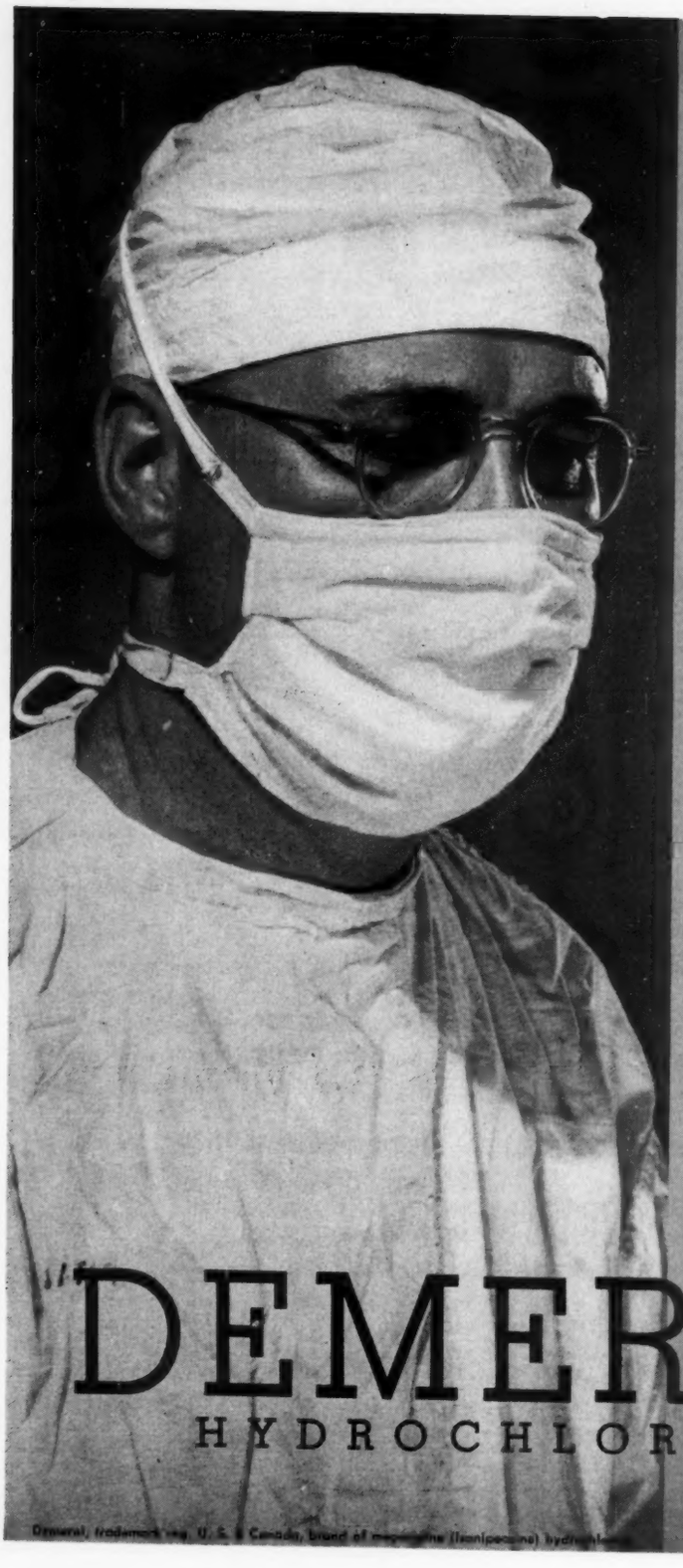

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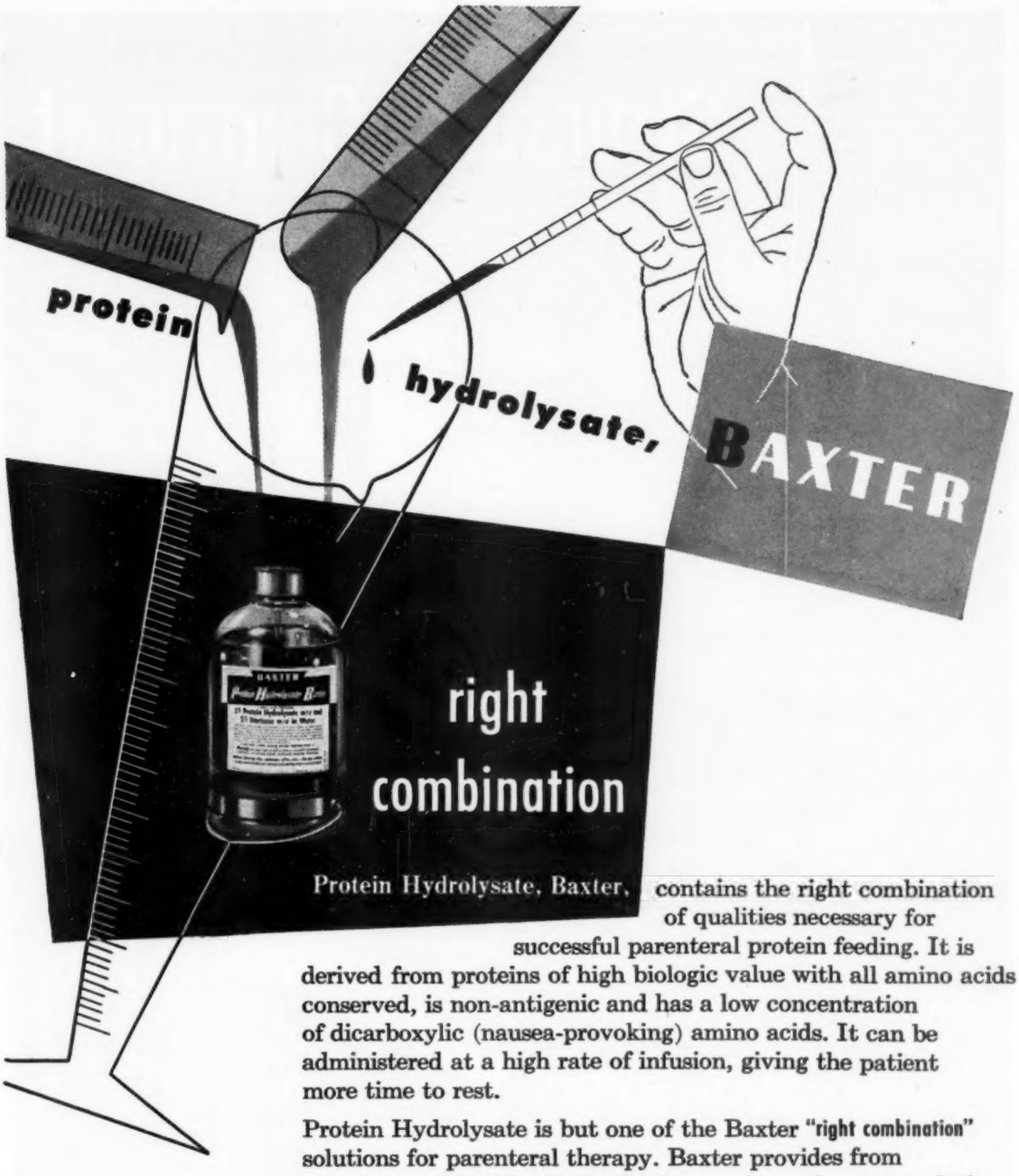

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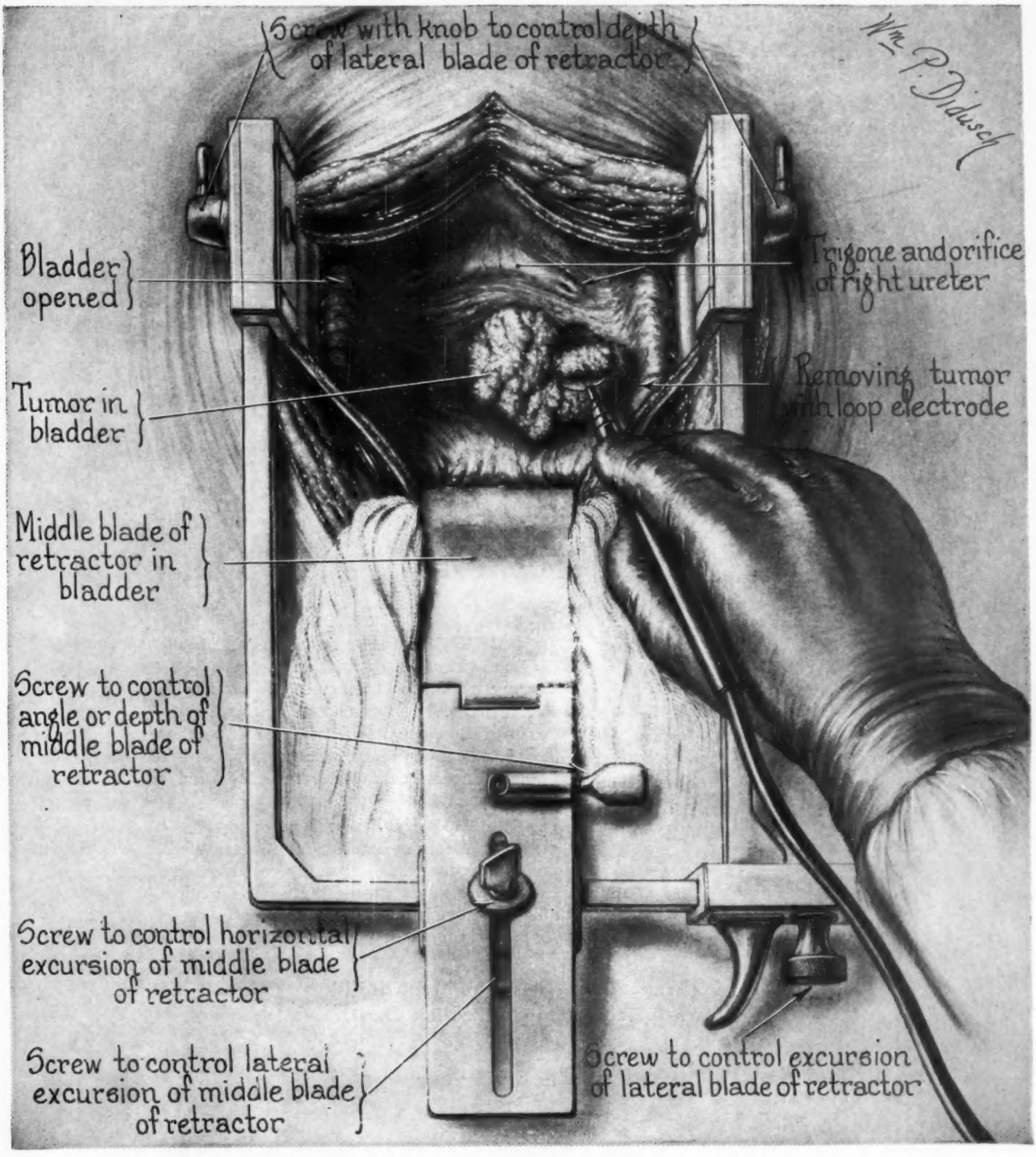
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Tumor in bladder
Removing tumor with loop electrode
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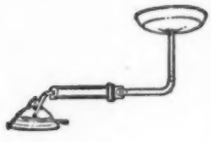

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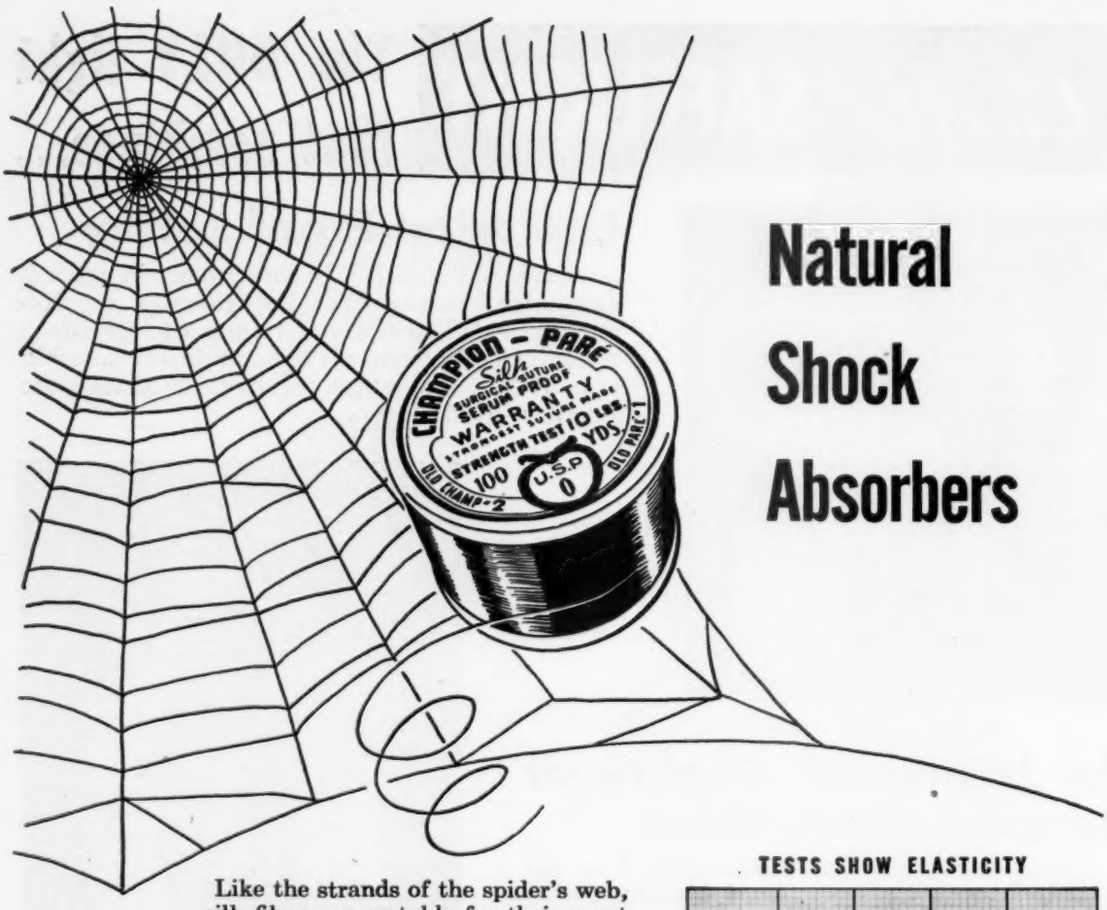

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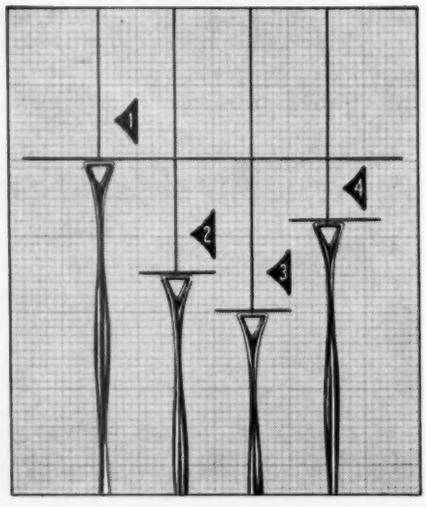

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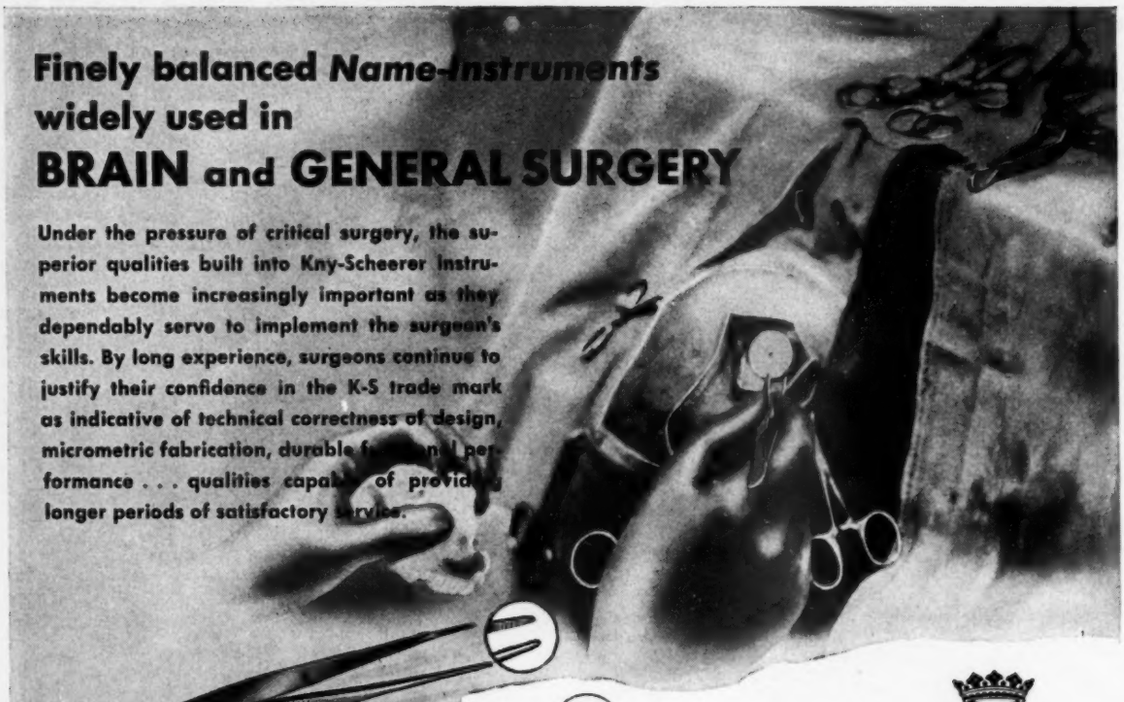

R430 . . . SEMKEN'S DRESSING FORCEPS
4¾", delicate, serrated tips.

R431 . . . SEMKEN'S TISSUE FORCEPS
4¾", delicate, 1x2 teeth.

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4¾", delicate, 2x3 teeth.

R2780 . . . ADSON'S TISSUE FORCEPS
5", serrated tips.

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5", 1x2 teeth.

★ **R2782¼ . . . CUSHING'S TISSUE FORCEPS**
6¾", straight, serrated tips, with dissecting end.

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6¾", straight, 1x2 teeth, with dissecting end.

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7½", bayonet type, serrated tips, with dissecting end.

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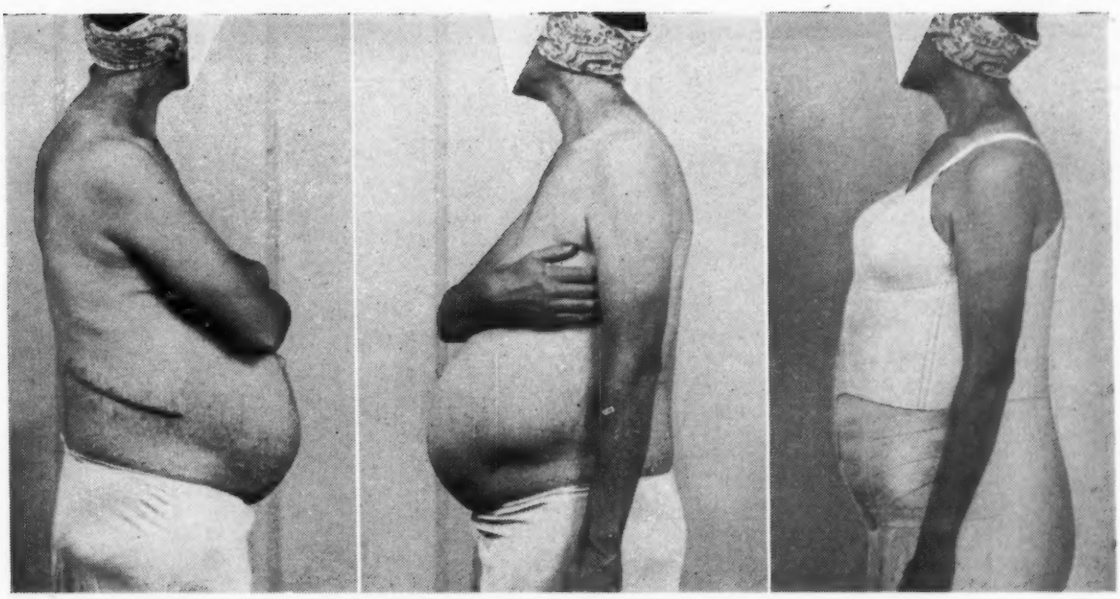
TRADE MARK

Kny-Scheerer quality instruments precision-made for discriminating surgeons.

★ **NOTE DISTAL ENDS . . . by a deft movement of the fingers, the surgeon also has at his command the equivalent of a dissecting instrument which may be employed with speed and without the distraction and time-consuming inconvenience of having to exchange instruments continuously.**

ORDER THROUGH YOUR DEALER or write for further information

KNY-SCHEERER CORPORATION
483 First Avenue **New York 16, N. Y.**



following Nephrectomy and Nephropexy

The patient pictured here, age 32, mother of 8 children, underwent nephrectomy (left kidney) in July, 1944. Two years later, nephropexy (right kidney) was performed, following which the ptosed abdominal organs failed to support the attached kidney properly. A Spencer was prescribed as adjunct to treatment and results were satisfactory. Abdominal organs were held in natural position to support the attached kidney adequately.*

SPENCER
IS THE SUPPORT OF CHOICE BECAUSE:

- Each Spencer is *individually designed, cut, and made* for each individual patient—thereby assuring the exact degree of support prescribed.
- In a Spencer, abdominal support is from below, upward and backward, paralleling the natural pull of muscles. The pull of supporting the abdomen is placed on the pelvis, not on the spine at or above the lumbar region.

*From case history records in our files.

For a dealer in Spencer Supports look in telephone book for "Spencer corsetiere" or "Spencer Support Shop", or write direct to us.

MAY WE SEND YOU BOOKLET?
139 Derby Ave., Dept. JS, New Haven 7, Conn.
SPENCER, INCORPORATED
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Please send booklet, "Spencer Supports in Modern Medical Practice."

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SPENCER *INDIVIDUALLY DESIGNED* SUPPORTS
®
FOR ABDOMEN, BACK AND BREASTS

IN the display cases of leading medical museums, many surgical instruments of earlier days, bearing the PILLING hallmark, testify to the significant contributions to Surgery made by Pilling during the past one hundred and thirty-two years.

The modern Pilling instruments pictured above, designed by acknowledged leaders in brain, obstetrical and general surgery, today embody the traditional qualities of authoritative design and superlative workmanship which have always distinguished instruments made by the house of Pilling since its founding in 1814.

Write today for illustrated literature describing Pilling instruments for Brain, Obstetrical and General Surgery. Address George P. Pilling & Son Company, 3451 Walnut Street, Philadelphia 4, Pa.

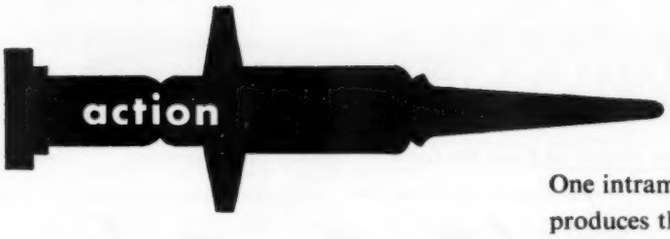
(1) P15150-51 Frazier Brain Retractors
(2) P18486 Jones Scissors
(3) P15424 Ferguson Suction Tube
(4) P16992 Sweet Scissors
(5) P15482 Adson Saw Carrier
(6) P9170 Harris Mercury Weighted Tube
(7) P20800 Kennedy Clamps
(8) P9140 Miller-Abbott Tube

INSTRUMENTS BY—
Pilling

INSTRUMENT CRAFTSMEN SINCE 1814

PAZILLIN is a uniform suspension of crystalline procaine penicillin G, 300,000 units/cc., in sesame oil and aluminum monostearate, and is stable for 1 year without refrigeration.

Single-injection, 4-day, systemic penicillin therapy for infections due to penicillin-sensitive organisms.



One intramuscular injection of PAZILLIN quickly produces therapeutic blood levels of penicillin G, and maintains them for at least 96 hours (4 days). Injection is practically painless.

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96-hour Procaine Penicillin G Crystalline in Sesame Oil and Aluminum Monostearate

SHARP & DOHME

For intramuscular injection. Supplied in 1-cc. disposable, plastic syringes, and in 10-cc. multiple-dose vials, 300,000 penicillin units per cc.

Sharp & Dohme, Philadelphia 1, Pa.

Give Your Hands the Finger Freedom They Need
...*Specify* ROLLPRUF Surgical Gloves

SATIN soft texture assures you snug fit, less constriction—unusual finger-tip sensitivity. Sheer but tough, they stand more sterilizings—flat-banded cuffs won't roll down, reduce tearing—outlast ordinary gloves; made of Pioneer-processed neoprene—free from allergen found in natural rubber. Specify Rollprufs from your supplier or write us today. The Pioneer Rubber Company, 753 Tiffin Road, Willard, Ohio.

Made of DuPont neoprene. Green in color for easier sorting.

PIONEER *Surgical Gloves*

The Result of Over 30 Years of Quality Glove Making

---

for the successful treatment of...

LEG ULCERS

the DAXALAN-DOME-PASTE BANDAGE TECHNIQUE as introduced by **DR. WILLIAM M. COOPER,** Director, Department of Peripheral Vascular Diseases—New York Polyclinic Medical School and Hospital.

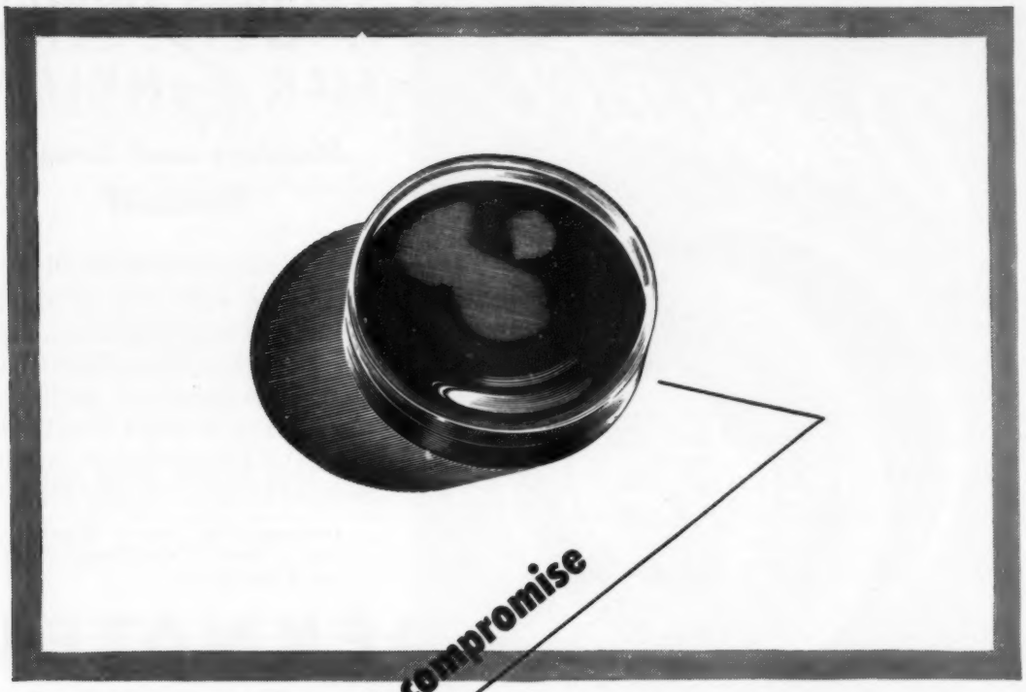
DOMEBORO TABS is listed as "BUROW'S SOLUTION-DOMEBORO TABS", on Page 376, in the "Manual of Dermatology"—issued under the auspices of the National Research Council and is recommended to be used wherever Burow's Solution is indicated.

This technique is based on a 3 point program—

1. Reduce the dermatitis with wet dressings of DOMEBORO TABS (BUROW'S SOLUTION).
2. Combat local infection and stimulate healing with thick application of DAXALAN in the center of the ulcer and surrounding areas.
3. Overcome venous insufficiency, statis and edema by wrapping DOME-PASTE BANDAGE (Unna's Boot) around the entire leg to supply compression.

DOCTOR!
You may now prescribe
SOOTHING
Modernized — Simplified
Fresh and Stable
BUROW'S SOLUTION
1:20
in four forms
DOMEBORO
Tablets • Packets • Powder
Ointment
Write for samples and reprints from medical literature

DOME CHEMICALS, INC.
250 EAST 43rd STREET NEW YORK 17, N. Y.
Makers of the Soothing, Modernized Form of Burow's Solution
DOMEBORO—Tablets • Powder • Packets • Ointment



Bacteria don't compromise

Nothing less than complete antiseptic action is satisfactory in surgical procedures. That is why such painstaking research preceded the development of Zephiran.

Pick any of the important attributes of a good antiseptic you want . . . prompt effectiveness, economy, safety . . . and you will find it in Zephiran chloride.

Zephiran chloride actually kills bacteria, it doesn't just inhibit them. It's fast in its action, too —faster than many other antiseptics. What's more, Zephiran is adequately germ*icidal* and less toxic than the mercurials.

For an antiseptic that is useful everywhere in hospital and office practice, SPECIFY

ZEPHIRAN® CHLORIDE

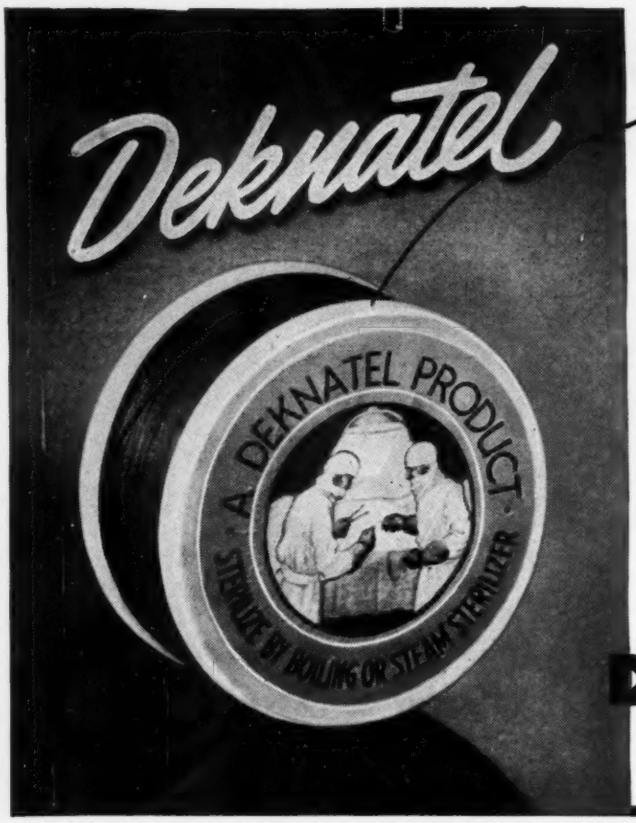
EFFECTIVE, SAFE, ECONOMICAL ANTISEPTIC

Winthrop-Stearns INC.

NEW YORK 13, N. Y. • WINDSOR, ONTARIO

Supplied as: Aqueous Solution 1:1000, bottles of 8 fl. oz. and 1 U. S. gallon. Tincture 1:000, tinted and stainless, bottles of 8 fl. oz. and 1 U. S. gallon. Concentrated Aqueous Solution 12.8%, bottles of 4 fl. oz. and 1 U. S. gallon (1 oz.=1 U. S. gallon 1:1000 solution).

Zephiran, trademark reg. U. S. & Canada, brand of benzalkonium chloride (refined).



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SILK NYLON

Moisture and Serum Resistant

Smooth, uniform, pliable suturing materials, braided and treated with meticulous care. Extra strong. Easy to work. Non-capillary, non-irritating, and non-culture mediums. Wide range of sizes, black and white, U.S.P. Resterilizable. Sold by Surgical-Hospital Supply Houses.

Deknatel is the Original Manufacturer of Braided and Treated Silk and Nylon Sutures.

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THE *Master Hand* DESERVES A *Master Blade*

More and more as surgeons (and their staffs) appreciate the fine quality inherent in Crescent blades—not only in the caliber of steel employed, but in the fabrication—are they standardizing on these master blades, so inexpensively priced. Discriminating operators find Crescent blades extra sharp, extra rigid, extra sensitively balanced—and therefore extra desirable. Test and compare! Samples gladly forwarded.

CRESCENT SURGICAL SALES CO., INC., 440 4th Ave., New York 16

Crescent

SURGICAL BLADES AND HANDLES

THE NEW YORK POLYCLINIC
MEDICAL SCHOOL AND HOSPITAL
(ORGANIZED 1881)

(The Pioneer Post-Graduate Medical Institution in America)

FOR THE GENERAL SURGEON

A combined surgical course comprising general surgery, traumatic surgery, abdominal surgery, gastro-enterology, proctology, gynecological surgery, urological surgery. Attendance at lectures, witnessing operations, examination of patients pre-operatively and post-operatively and follow-up in the wards post-operatively. Pathology, roentgenology, physical therapy. Cadaver demonstrations in surgical anatomy, thoracic surgery, regional anesthesia. Operative surgery and operative gynecology on the cadaver.

EYE, EAR, NOSE and THROAT

A three months combined full time refresher course consisting of attendance at clinics, witnessing operations, lectures, demonstration of cases and cadaver demonstrations; operative eye, ear, nose and throat on the cadaver; clinical and cadaver demonstrations in bronchoscopy; laryngeal surgery and surgery for facial palsy; refraction; radiology; pathology; bacteriology; embryology; physiology; neuro-anatomy; anesthesia; physical therapy; allergy; examination of patients pre-operatively and follow-up post-operatively in the wards and clinics.

FOR THE GENERAL PRACTITIONER

Intensive full time instruction in those subjects which are of particular interest to the physician in general practice, consisting of clinics, lectures and demonstrations in the following departments—medicine, pediatrics, cardiology, arthritis, chest diseases, gastroenterology, diabetes, allergy, dermatology, neurology, minor surgery, clinical gynecology, proctology, peripheral vascular diseases, fractures, urology, otolaryngology, pathology, radiology. The class is expected to attend departmental and general conferences.

ANESTHESIA

A three months full time course covering general and regional anesthesia, with special demonstrations in the clinics and on the cadaver of caudal, spinal, field blocks, etc.; instruction in intravenous anesthesia, oxygen therapy, resuscitation, aspiration bronchoscopy.

FOR INFORMATION ADDRESS

MEDICAL EXECUTIVE OFFICER, 345 West 50th Street, NEW YORK 19

COOK COUNTY
GRADUATE SCHOOL OF MEDICINE

Announces continuous courses

SURGERY—Intensive Course in Surgical Technique, Two Weeks, Starting June 20, July 25, August 22.
Surgical Technique, Surgical Anatomy & Clinical Surgery, Four Weeks, Starting June 6, July 11, August 8.
Surgical Anatomy & Clinical Surgery, Two Weeks, Starting May 16, June 20, July 25.
Surgery of Colon & Rectum, One Week, Starting June 13, September 12.
Esophageal Surgery, One Week, Starting June 13.
Thoracic Surgery, One Week, Starting June 20.
Fractures & Traumatic Surgery, Two Weeks, Starting June 13, October 3.

GYNECOLOGY—Intensive Course, Two Weeks, Starting June 20, September 26.
Vaginal Approach to Pelvic Surgery, One Week, Starting May 16, June 13, September 19.

OBSTETRICS—Intensive Course, Two Weeks, Starting May 16, September 12.

MEDICINE—Intensive General Course, Two Weeks, Starting June 13, October 3.
Electrocardiography & Heart Disease, Two Weeks, Starting July 18.
Gastroenterology, Two Weeks, Starting June 27.
Personal Course in Gastroscopy, Two Weeks, Starting May 16, June 13.

PEDIATRICS—Diagnosis & Treatment of Congenital Malformations of Heart, Two Weeks, Starting June 13.
Personal Course in Cerebral Palsy, Two Weeks, Starting August 1.

DERMATOLOGY—Formal Course, Two Weeks, Starting June 13.
Informal Clinical Course Every Two Weeks.

CYSTOSCOPY—Ten Day Practical Course Every Two Weeks.

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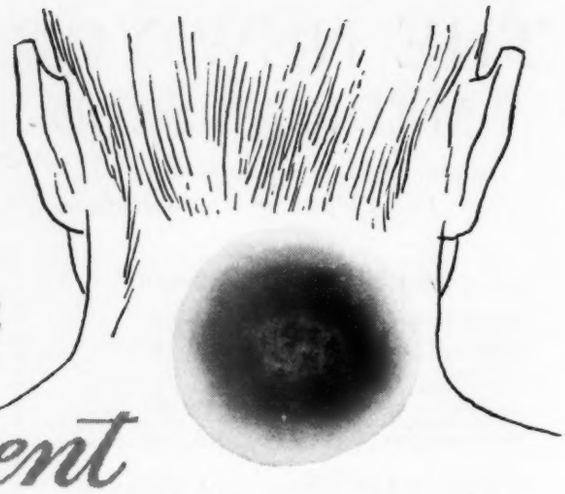
GENERAL, INTENSIVE AND SPECIAL COURSES IN ALL BRANCHES OF MEDICINE, SURGERY AND THE SPECIALTIES

TEACHING FACULTY—ATTENDING STAFF
of Cook County Hospital

Address: Registrar, **427 South Honore Street, Chicago 12, Illinois**



Conservative Management WITH BACITRACIN

CSC

REDUCES THE NEED FOR INCISION

In the management of carbuncle and a host of other local cutaneous infections the early use of bacitracin greatly reduces the need for incision and drainage in a vast majority of patients. Injected directly into the lesion, bacitracin (500 U./cc. in sterile isotonic sodium chloride solution) exerts a profound antibiotic influence upon the invading pyogens. Bacitracin is particularly effective in the presence of penicillin-resistant staphylococci and streptococci, and in mixed infections. Topical administration of bacitracin solution hastens resolution, minimizes pain, and in most cases averts the need for local surgery.

Bacitracin, topically administered, is a valuable means of treating a wide variety of local infectious processes. Physicians are invited to send for descriptive literature.

SUPPLY

Bacitracin-C.S.C. is supplied in 20 cc. size rubber-stoppered vials containing 2,000 and 10,000 units, and in 50 cc. rubber-stoppered vials containing 50,000 units.

C.S.C. Pharmaceuticals

A DIVISION OF COMMERCIAL SOLVENTS CORPORATION, 17 EAST 42ND STREET, NEW YORK 17, NEW YORK

NEW CAST TECHNICS

Spicas - Club Feet - Jackets

EASIER • QUICKER • BETTER

For quicker setting and faster drying, lighter, stronger and more easily applied casts, many doctors have discovered the unique advantages of using glass-plastic in combination with their plaster-of-Paris.

TECHNIC: Simply apply the *thinnest* possible shell of a good grade of plaster on the patient. Molding will be made easier and the quick setting will minimize problems of holding. Complete cast immediately thereafter by applying a *thin* shell and reinforcements of Aire-Cast* *right on top of the wet plaster.*

The Aire-Cast sets in a matter of minutes, aided by the heat of the setting plaster. The combination cast thus rapidly attains a substantial strength which permits the patient to be moved in shortest possible time.

This combination cast is surprisingly strong, light, durable, non-crumbling and quick drying. The extreme thinness of the plaster portion will reduce the usual obstruction to X-ray.

Enhance the molding and quick-setting properties of a good plaster with the strength, lightness, durability, non-crumbling, and quick drying to be found only in Aire-Cast.*

Special Technics, p. 4.

*NOTE: The lightest, strongest quickest-drying and most durable cast is one made entirely of Aire-Cast. This has unique advantages of being porous, X-ray transparent, applied without mess, non-absorbing, and unaffected by water.

SAVES TIME AND EXPENSE *because:*

- **Quick setting and rapid drying shorten time in surgery**
- **Rapid drying and high strength hasten early ambulation**
- **High strength and light weight shorten hospitalization**
- **Toughness and permeability eliminate need of frequent cast changes**

*Trade Mark of a plastic cast bandage made by The Tower Company

Obtainable through leading dealers ***Further information sent upon request***

THE TOWER COMPANY, Inc.

Manufacturing and Research Specialists in Fracture and Surgical Equipment

SEATTLE 14, WASHINGTON
P. O. Box 3181

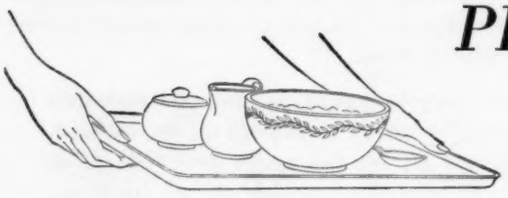
TOWER

GENEVA, ILLINOIS
(near Chicago)

Readily Accepted

EASILY DIGESTED

PROMPTLY UTILIZED



THE convalescent patient appreciates more than just the attractiveness and the appetite appeal of the breakfast cereal on the meal tray. He appreciates also the satiety value and the easy digestion of this nutritious breakfast dish. Following illness, when food interest ordinarily is low and the digestive processes are slowed, all of these values may mean much to the progress of the patient.

The breakfast cereal serving—breakfast cereal, milk, and sugar—is singularly adapted to the nutritional needs in illness and convalescence when the diet frequently has to be limited. Its nutrient content of protein of high biologic value, of carbohydrate and fat, and of vitamins and minerals is exceptionally well balanced. Its appealing taste makes it a universally accepted favored dish. The many kinds of breakfast cereals available make for welcome variety. Because of its bland taste, the cereal serving blends readily with all other foods.

The nutrient composition of the breakfast cereal serving made from 1 ounce of breakfast cereal,* 4 fluid ounces of milk, and 1 teaspoonful of sugar is shown in the table.

The presence of this seal indicates that all nutritional statements in this advertisement have been found acceptable by the Council on Foods and Nutrition of the American Medical Association.

CALORIES	202	**PHOSPHORUS**	206 mg.
PROTEIN	7.1 Gm.	**IRON**	1.6 mg.
FAT	5.0 Gm.	**VITAMIN A**	193 I.U.
CARBOHYDRATE	33.0 Gm.	**THIAMINE**	0.17 mg.
CALCIUM	156 mg.	**RIBOFLAVIN**	0.24 mg.
NIACIN	1.4 mg.		

**Composite average of all breakfast cereals on dry weight basis.*

CEREAL INSTITUTE, INC.

135 South La Salle Street • Chicago 3

A RESEARCH AND EDUCATIONAL ENDEAVOR DEVOTED TO THE BETTERMENT OF NATIONAL NUTRITION

...a product

serving many purposes

Short-acting Nembutal also is a product that serves many purposes. More than 44 effective uses for it have been described in over 480 published reports. Clinical experience during the past 19 years has shown that adjusted doses of short-acting Nembutal can bring about any desired degree of cerebral depression—from mild sedation to deep hypnosis. Dosage required is only about *one-half* that of many other barbiturates. Small dosage means (1) less drug to be inactivated; (2) shorter duration of effect; (3) wide safety margin; (4) less possibility of barbiturate "hangover," and (5) definite economy to the patient. Shown at right is a partial list of indications for short-acting Nembutal. A glance at it may suggest new ways in which you can use the drug. Write for the new booklet "44 Clinical Uses for Nembutal." ABBOTT LABORATORIES, North Chicago, Illinois.

In equal oral doses, no other barbiturate combines **QUICKER, BRIEFER, MORE PROFOUND EFFECT** than ... **Nembutal®**
(Pentobarbital, Abbott)

Have you tried EPHEDRINE AND NEMBUTAL CAPSULES AND NEMBU-FEDRIN® CAPSULES *for the symptomatic relief of bronchospasm in certain cases of hay fever and asthma?*

44 of Nembutal's Clinical Uses

sedative

Cardiovascular
Hypertension[1]
Coronary disease[1]
Angina[1]
Decompensation
Peripheral vascular disease

Endocrine Disturbances
Hyperthyroid
Menopause—female, male

Nausea and Vomiting
Functional or organic disease (acute gastrointestinal and emotional)
X-ray sickness
Pregnancy
Motion sickness

Gastrointestinal Disorders
Cardiospasm[2]
Pylorospasm[2]
Spasm of biliary tract[2]
Spasm of colon[2]
Peptic ulcer[2]
Colitis[2]
Biliary dyskinesia

Allergic Disorders
Irritability
To combat stimulation of ephedrine alone, etc.[3,1]

Irritability Associated With Infections[4]

Restlessness and Irritability With Pain[5,4]

Central Nervous System
Paralysis agitans
Chorea
Hysteria
Delirium tremens
Mania

Anticonvulsant
Traumatic
Tetanus
Strychnine
Eclampsia
Status epilepticus
Anesthesia

hypnotic

Induction of Sleep

obstetrical

Nausea and Vomiting
Eclampsia
Amnesia and Analgesia[6]

surgical

Preoperative Sedation
Basal Anesthesia
Postoperative Sedation

pediatric

Sedation for:
Special examinations
Blood transfusions
Administration of parenteral fluids
Reactions to immunization procedures
Minor surgery

Preoperative Sedation

Nembutal alone or
[1]*Glucophylline® and Nembutal,*
[2]*Nembutal and Belladonna,*
[3]*Ephedrine and Nembutal,*
[4]*Nembudeine®,*
[5]*Nembutal and Aspirin,*
[6]*with scopolamine or other drugs.*

Outside the Ivory Tower

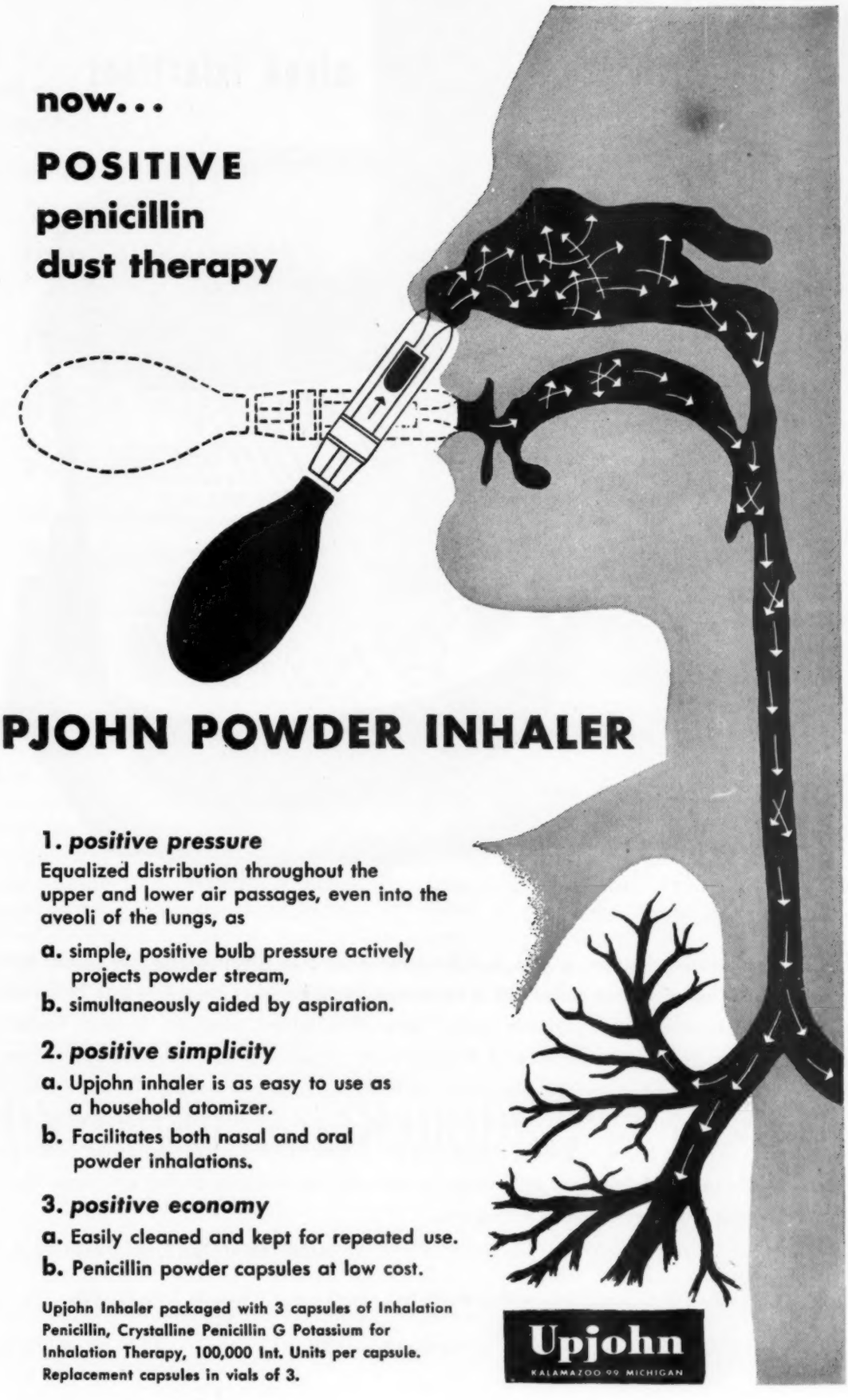
GERIATRICS was the subject of an all-day Medical Research Conference held Wednesday, March 16, 1949, as part of the opening ceremonies of the new $7,000,000 building of Smith, Kline & French Laboratories, Philadelphia pharmaceutical manufacturers. Leading medical authorities from all parts of the country assembled to discuss the clinical problems of advancing years. Over 800 physicians attended the Conference. The firm's guests were welcomed by C. Mahlon Kline, President and Chairman of the Board, Smith, Kline & French Laboratories, and Dr. William L. Long, the Company's Medical Director. W. Furness Thompson, Vice-president in charge of the Company's Research Division, presided and introduced Dr. E. J. Stieglitz, well known geriatrician who delivered the keynote address. Dr. Stieglitz is Attending Internist at the Suburban Hospital, Bethesda, Md. and Chestnut Lodge Sanitarium, Rockville, Md., Washington, D. C.

One of the major clinical problems confronting physicians treating the aged is dealing with cardiovascular diseases. Dr. Eugene A. Stead, Jr., Professor of Medicine at Duke University, was chairman of a panel discussion on this topic. Other members of this panel were Dr. Arlie Ray Barnes, Mayo Clinic, Professor of Medicine, Mayo Foundation Graduate School, University of Minnesota; Dr. George E. Burch, Henderson Professor of Medicine, Tulane University School of Medicine; Dr. Harry Gold, Professor of Clinical Pharmacology, Cornell University Medical College and Dr. Robert W. Wilkins, Associate Professor of Medicine, Boston University School of Medicine. Dr. Morris Fishbein, Editor of the Journal of the American Medical Association, introduced a number of pharmacologic experi-

(*continued on page* 36)

now...

POSITIVE penicillin dust therapy



UPJOHN POWDER INHALER

1. *positive pressure*

Equalized distribution throughout the upper and lower air passages, even into the aveoli of the lungs, as

a. simple, positive bulb pressure actively projects powder stream,

b. simultaneously aided by aspiration.

2. *positive simplicity*

a. Upjohn inhaler is as easy to use as a household atomizer.

b. Facilitates both nasal and oral powder inhalations.

3. *positive economy*

a. Easily cleaned and kept for repeated use.

b. Penicillin powder capsules at low cost.

Upjohn Inhaler packaged with 3 capsules of Inhalation Penicillin, Crystalline Penicillin G Potassium for Inhalation Therapy, 100,000 Int. Units per capsule. Replacement capsules in vials of 3.

Upjohn
KALAMAZOO 99, MICHIGAN

Experientia
Endocet

For mixed infections

FURACIN"
SOLUBLE DRESSING
(BRAND OF NITROFURAZONE)
CONTAINS 0.2% NITROFURAZONE (5-NITRO-2-FURALDEHYDE SEMICARBAZONE) IN A WATER SOLUBLE BASE.
CAUTION: TO BE DISPENSED ONLY BY OR ON THE PRESCRIPTION OF A PHYSICIAN.
DESCRIPTION OF PRODUCT AND USES AVAILABLE TO PHYSICIANS ON REQUEST.
AN ANTIBACTERIAL PREPARATION FOR TOPICAL APPLICATION.
LABORATORIES Inc.
NORWICH, NEW YORK
ONE POUND, AVOIR

When fecal contamination of the postoperative wound is unavoidable, the effectiveness of Furacin against many gram-negative and gram-positive organisms has been shown to be of value. Shipley et al.* reported its prophylactic use in 2 cases of colostomy, where the incisions healed by early granulation even in the presence of fecal material. McGivney* recommended application of Furacin Soluble Dressing to postoperative anorectal wounds at each examination. Furacin® brand of nitrofurazone, is available as Furacin Soluble Dressing (N.N.R.) and Furacin Solution (N.N.R.) containing 0.2 per cent Furacin. These preparations are indicated for topical application *in the prophylaxis or treatment of infections of* wounds, second and third degree burns, cutaneous ulcers, pyodermas and skin grafts. *Literature on request.*

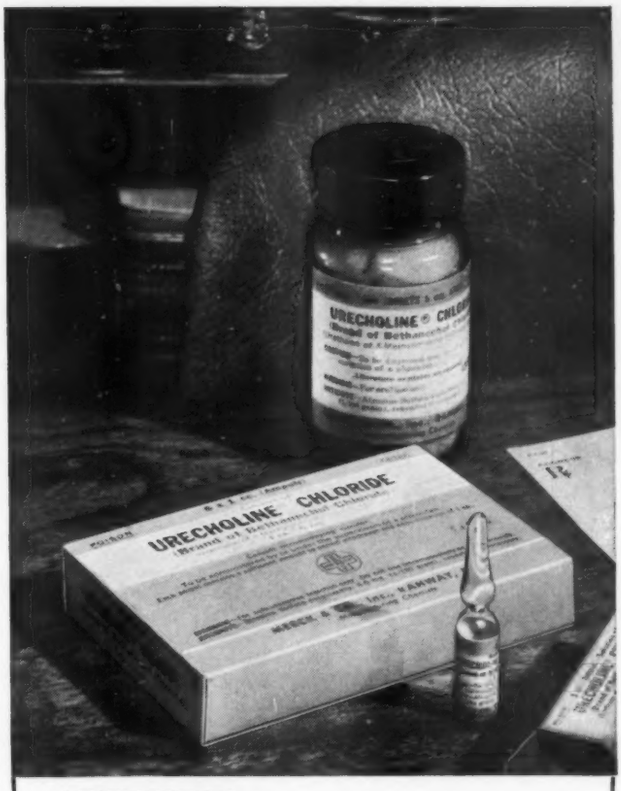
EATON LABORATORIES, INC., NORWICH, N. Y.

*Shipley, E. R. and Dodd, M. C.: Surg., Gynec. & Obst. 84:366, 1947. • McGivney, J.: South. M. J. 41:401, 1948.

For symptomatic relief in

POSTOPERATIVE ABDOMINAL DISTENTION

and Gastric or Urinary Retention



AVAILABLE IN

Bottles of 100, 5 mg. tablets for oral use only . . .

And cartons of six 1 cc. ampuls, 5 mg. per cc., for subcutaneous injection only.

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This agent is highly effective in the prevention and relief of the distressing symptoms of gastric atony and retention following vagotomy.

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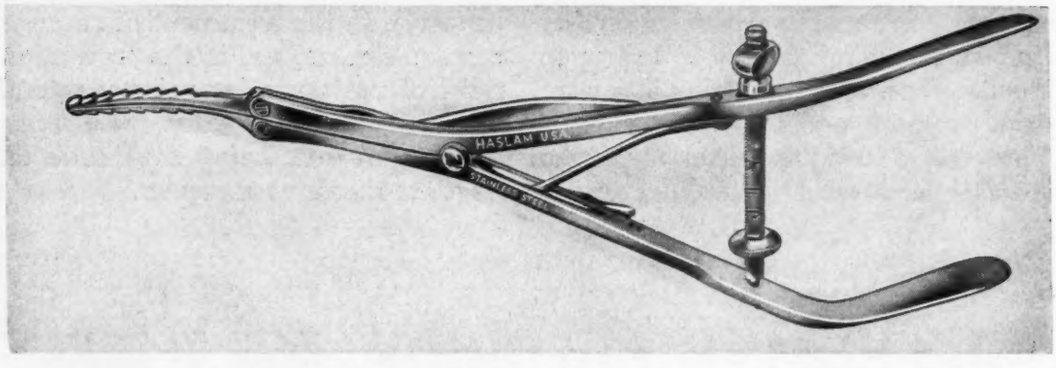

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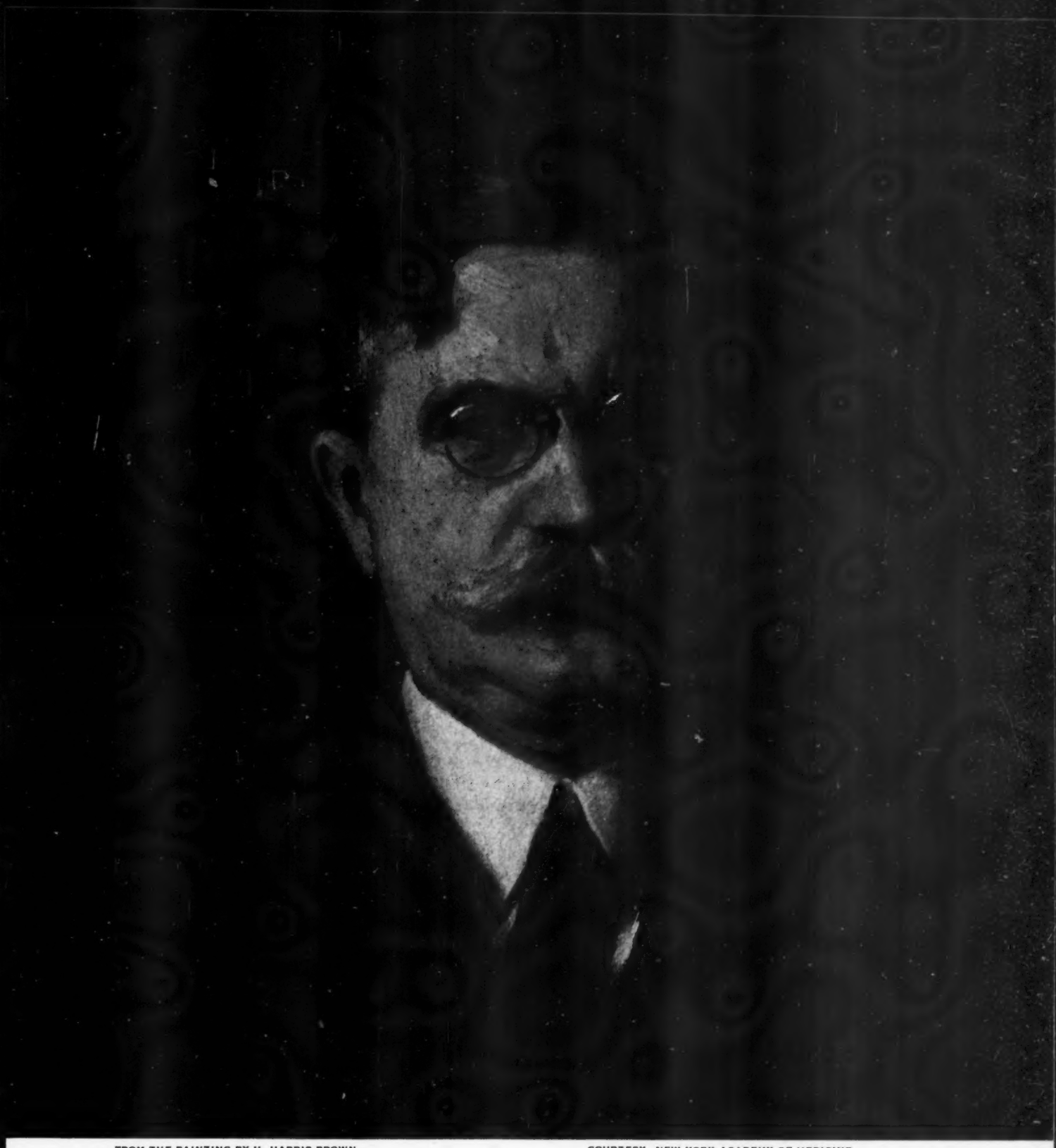

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George David Stewart

1862-1933

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Dr. Stewart was born in Cumberland County, Nova Scotia. In 1899 he was graduated from Bellevue Hospital Medical College (New York University). Later he was professor of surgery at N.Y.U.; in 1916, head of surgery.

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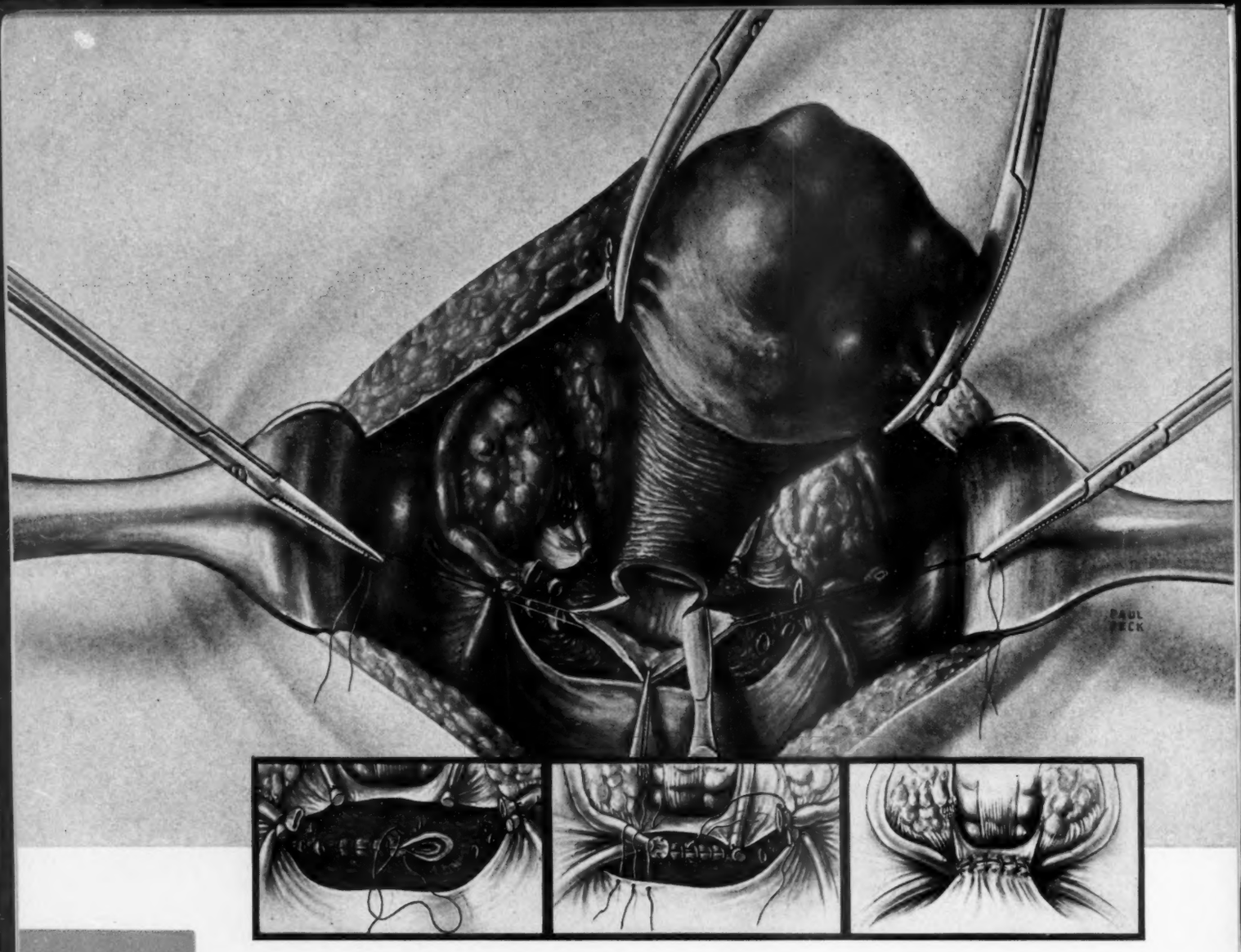

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This trend has been revealed by Ethicon's recent six-month study in many prominent hospitals. As a result, a new group of 13 Ob. and Gyn. eyeless needle sutures has been developed. There are four new needles, swaged to chromic gut, sizes 3-0 to 2.

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The illustrations at the right show the contrast between the old style eyed needle and the new streamlined, eyeless Atraloc needle supplied by Ethicon.

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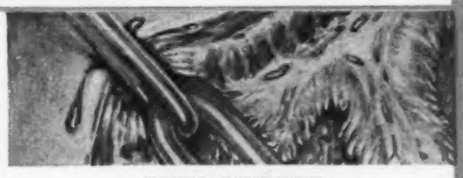
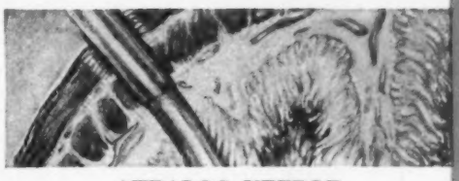


EYED NEEDLE



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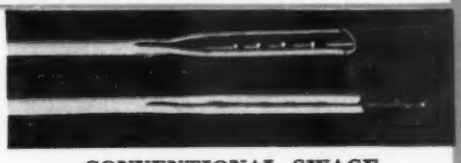

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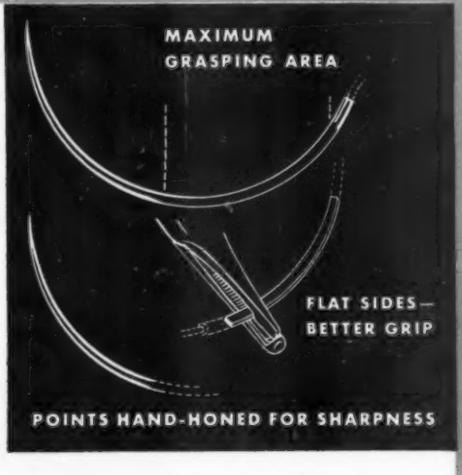

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A PRACTICAL JOURNAL BUILT ON MERIT

Fifty-eighth Year of Publication

VOL. LXXVII MAY, 1949 NUMBER FIVE

Editorials

TIME TO STREAMLINE MEDICAL PAPERS

AT a meeting of the Western Surgical Association held in St. Louis in December, 1948, the writer presented a paper on carcinoma of the thyroid gland. Thirteen minutes were devoted to the paper, including three minutes for the introduction. The latter had nothing to do with the problem but it is the basis for this brief editorial.

This was the introduction: "For years it was traditional never to give iodine to a patient having exophthalmic goiter, and it was always customary to drain in a case of ruptured appendicitis with peritonitis. Universally, patients were confined to their beds for one or more weeks following operation. Spinal anesthesia was considered a dangerous anesthetic to be used only in rare instances. Thousands of yards of gauze and adhesive tape were piled upon the patient's abdominal incisions in the hope of protecting the incision from contamination and of strengthening the wound." My entire thirteen minutes could have been devoted to discussion of traditional ideas in surgery whose abandonment years ago might have saved thousands of lives which were unnecessarily sacrificed to the gods of tradition. Tradition is the enemy of progress.

I believe we have come to a new era in medical writing. In this busy world we have little time to read long medical articles in the traditional style of 1748, 1848 or 1948. Instead we read the summary and if it interests us, we may turn back and review a few paragraphs and occasionally the entire article. My grandfather confined his journalistic reading to Lancet, Annals of Surgery and The Journal of the American Medical Association. Father added one or two more, and it was said of him that he could quote from memory the title, year, month and author of the most important articles on surgery. Today this entire page could be devoted to the names of the medical journals that come to our desks from all over the world. One must sort through a great quantity of chaff before he reaches the wheat. Although it is true that several journals are devoted largely to abstracts, even the review of these is time-consuming when time becomes more and more precious. Abstracts are only a "come on" and never satisfy me.

Much that appears in medical literature today has already been said not once but a hundred times or more. A friend of mine in Colorado said in reply to my question as to why he chose to live in the wide open spaces, "Because there is an awful lot of land where an awful lot of people that I don't like aint living." One might say that there are an awful lot of medical articles written about an awful lot of subjects that an awful lot of doctors have already covered. I plead guilty to this along with the rest.

Paper and labor are expensive and time and eyesight are more so. So my paper on cancer of the thyroid was condensed to ten minutes at St. Louis and, judging from the comments, it was far better received than if it had taken two or three times as long. In streamlining this article by first presenting my conclusions after the manner of the press and by amplifying the most important of these facts in the remaining minutes, I hoped to set a style in medical writing that would encourage others to abandon the traditional form of the past. No one is particularly interested in reading long historical reviews on the subject unless he expects to write along similar lines. One or two minutes for this phase is sufficient; so, too, for theories. Signs and symptoms can be appreciated and better remembered if tabulated; pathologic descriptions of a particular condition are important but can be condensed; surgical technic can be given with as few embelishments; photographs and drawings often speak better than words.

Most surgical journals, in fact, most medical journals have such a tremendous backlog of articles on hand that it will be months and perhaps years before some articles will appear. Many of these articles could be briefed and still be accurate and informative. Because time is moving so fast and advancement in medical progress is so rapid, some articles are almost out of date when they finally appear. Certain types of papers, particularly those dealing with research studies, cannot be placed under the subject of this editorial, yet some of these also might stand a little trimming.

That this new style of streamlined paper meets with approval may be judged from the comments of two surgeons who attended the meeting: Mr. Guy Blackburn of Guy's Hospital, London, wrote, "I enjoyed your paper more than any I heard at the two meetings. You condensed so much into so short a time that it would be an excellent thing if more people were encouraged to do likewise." Dr. H. H. Searls, San Francisco, said, "Your exposition of the material was a marvelous concentration, giving the most in the least time that I have ever heard." There was nothing unusual about the paper. It was liked simply because it was streamlined.

ARNOLD S. JACKSON, M.D.

Dr. Jackson offers medical authors a new way of writing scientific papers. It is obvious that all surgical manuscripts do not come under this category, but one confined to a new clinical point, a new surgical technic or a case history can well be "streamlined." Due to many factors beyond our control, a large backlog of papers are in our files. We are asking some authors to shorten their articles and others to streamline their manuscripts. In this way our backlog will get earlier publication. We hope to publish all accepted material in six to nine months' time. Therefore, we suggest, if you contemplate writing a scientific article, that you consider whether or not it can be streamlined. It might be well to reread and study Dr. Jackson's editorial and then practice this new technic. If we receive enough streamlined papers, we will devote a department to such communications. Should you wish further information on this matter, drop us a line.

EDITOR

IS THE WORD "SHOCK" ABSOLUTELY NECESSARY?

THE word "shock" connotes much that is unpleasant to the doctor. He may have been exposed and sensitized to it during medical school by having been asked the question, "What is shock and how do you treat it"? Later he may have observed a baby or an old man who needed an operation as a life-saving measure, but such help was withheld because it was presumed that the patient could "never stand the shock." Perhaps he was admonished not to apply pain-relieving dressings to a severely burned patient as a preliminary measure but rather to treat the "shock." No doubt he has seen patients returned to the wards from the operating room in a dying or near dying condition. "Shock" he was told. He may have seen individuals near death from infections of both the medical and surgical type. They were pulseless and covered with the cold sweat of the agonal period. "Shock!"

What is shock? Webster's Collegiate Dictionary gives six definitions. It is (1) the impact of individuals or groups in combat; (2) a blow, impact or collision or a violent shake or jar, also the effect of such violence as an earthquake shock; (3) a sudden agitation of the mental or emotional sensibilities or an event causing this; (4) (colloq.) a stroke of paralysis; (5) the sudden stimulation caused by the discharge through the animal system of electricity; and (6) (Med.) a state of profound depression of the vital processes resulting from wounds, hemorrhage, crushing injuries, blows, etc." Thus, the word has five distinct meanings before the medical definition is reached.

Some writers on the subject have tried to define shock; other have advised against the attempt. In his extensive review of the subject Harkins[1] lists a number of definitions which have been proposed since the year 1826. Some examples: "A manifestation of a rude unhinging of the machinery of life" (Gross, 1872). "The reaction of the central nervous system to exaggerated or abnormal afferent impulses" (Gray and Parsons, 1912). "A condition of suddenly developing general damage" (Selye, Dosne, Bassett and Whittaker, 1940). Harkins himself proposed a brief definition stating that shock is "a progressive vasoconstrictive oligemic anoxia." For a descriptive definition, he offered: "An oligemia initiated by traumatic local fluid loss, either whole blood, plasma or both; accompanied by decreased cardiac output, diminished volume flow, lowered venous pressure, decreased oxygen consumption, arteriolar vasoconstriction, acapnia and secondary blood pressure fall; and perpetuated by a summation of these factors and possibly hyperpotassemia, increased generalized capillary permeability, anoxia, action of tissue metabolites and deficiency of adrenal cortical hormone."

In his book on the principles of surgical care Blalock[2] stated that most of the attempts that have been made to define shock have confused rather than clarified the subject. He mentioned that Cannon was of the opinion that definition was not a prime requisite in such a complex as shock, and that O'Shaugnessy and Slome had suggested that the difficulty in definition would be overcome by abandoning the attempt and providing instead a clinical picture of the syndrome.

This brings us to the question posed by this communication. Could we go a step further and not only abandon attempts to define the word but abandon it altogether?

Practice in doing without the word shock can be obtained by taking surgical texts and articles and marking out the offender,

[1] HARKINS, H. N. Recent advances in the study and management of traumatic shock. *Surgery*, 9: 231, 447, 607, 1941.

[2] BLALOCK, ALFRED. Principles of Surgical Care: Shock and Other Problems. St. Louis, 1940. C. V. Mosby.

substituting words more descriptive of the actual conditions. After becoming proficient, one can proceed to apply the new art in the writing of actual clinical histories and operating room notes.

The following sample sentences are supplied to encourage the beginner. In each instance the italicized words are to be replaced by the words in parentheses which follow: (1) The patient is admitted following a traumatic amputation of the leg, *in a state of shock* (with low blood pressure because of severe hemorrhage). (2) During the application of the traction apparatus for the fracture of the femur, the patient *went into shock* (developed a weak, fast pulse, probably due to local loss of blood about the fracture site or to undiagnosed extravascular collections of blood). (3) Following radical mastectomy, the patient was returned to her room in *profound shock* (poor condition due to inadequate blood replacement during the operation). (4) We will give this severely burned patient a liter of blood in order to *prevent burn shock* (maintain blood volume). (5) This patient has a board-like abdomen and *is in shock* (is in great pain and has a weak pulse). (6) For a minor operation, we gave the patient a spinal anesthetic and he immediately *went into shock* (showed an exaggerated vasodilator response as evidenced by the transient hypotension).

The indications for rational treatment in the six hypothetical cases given above are clearer if one uses the more explanatory phrases. Whole blood would be given to the first three, without wasting time with other measures. Blood or plasma would suffice for the fourth. Morphine and an operation for perforated ulcer would probably correct the weak pulse in the fifth case. The adequate use of the vasoconstrictor drugs will prevent or remedy the hypotension associated with spinal anesthesia.

Is it possible that a dictionary of the year 2000 would contain the following "Shock: (obs.) medical term formerly used in connection with a number of pathologic states in which there was low blood pressure and other evidences of depression of the vital processes"?

CONRAD R. LAM, M.D.

Original Articles

THE VAGINA IN RECONSTRUCTIVE SURGERY*

A HISTOLOGIC STUDY OF ITS STRUCTURAL COMPONENTS

J. V. Ricci, M.D., J. R. Lisa, M.D., C. H. Thom, Jr., M.D. and W. Kron, M.D.
New York, New York

PLASTIC surgery for the correction of relaxations, lacerations, fistulous formations and descents of the urethro-vesico-ano-recto-genital parts necessitates in all instances an invasion of the vaginal wall. For this reason a thorough understanding of the histologic structure of this organ is essential.

A review of the literature dealing with this subject reveals a multitude of contradictory views. In 1886 J. Henle[1] described and depicted in a free-hand drawing the structural elements of the adult vagina, labelling the histologic components vaginal epithelium, submucosa, an inner layer of longitudinal muscle fibers and an outer layer of circular muscle fibers. H. Luschka[2] two years later (1868) reversed the order of the muscular layers. In 1871 M. Lowenstein[3] described gland-like crypts and lymph follicles similar in structure to the solitary glands of the small intestines. A. Breisky[4] in 1887 reporting for himself, Eppinger and Toldt, after examination of a number of specimens, stated that the inner muscular layer was transversely arranged and the outer layer was longitudinally arranged. Breisky added that this pattern prevailed when the section fell exactly upon a columna, especially the anterior one, but he agreed with Eppinger and Toldt that the muscular layers conformed with the general muscular structure of the uterus. This view also explained in a more satisfactory manner the circular contractions of the vagina occasionally met with clinically. Toldt had found an external dense layer of longitudinal fibers and an inner non-continuous layer in which the fibers were mostly circular with some longitudinal and oblique fibers. He also observed lymph-follicle bodies in the mucosa.[5]

According to F. von Preuschen[6] the deepest layers of the mucous membrane of the vagina contained cylindrical cells with elongated nuclei. In the crypts of the mucosa of the upper vagina were conglomerate glands lined with ciliated epithelium. Breisky stated that the above view was supported by Huckel and Heitzman. C. Ruge found a very distinct glandular structure on the inner surface of the hymen in a case of atresia hymenalis. A. C. Cowperthwaite,[7] in 1888, after microscopic and "sectional" examination reported that the mucous membrane was made up of epithelium (the superficial layer being squamous and nucleated; the deeper layer, cylindrical with elongated nuclei), connective tissue, elastic tissue and some unstriped muscle fiber. The superficial layer of connective tissue formed papillae into which blood vessels projected. External to this epithelial layer, lay two layers of unstriped muscular fibers; the inner longitudinal, the outer circular. Thus he agreed with Henle on the muscular arrangement and credited Breisky with the view that the inner layer of muscle was of circular arrangement.

A. Macalister[8] (1889) stated that the vagina consisted of a stratified scaly epi-

* From the Departments of Gynecology and Pathology, City Hospital, New York, N. Y.

thelium, a dense corium with many papillae and glands, a vascular erectile lamina with many venous plexuses, a layer of unstriped circular muscle, a layer of longitudinal unstriped muscle and a dense outer areolar layer. Outside this was the striped sphincter vaginae, at the vulval end of the passage only, extending to but not beyond the triangular ligaments. In 1900 A. A. Bohm and M. von Davidoff[9] described the three coats of the vagina as mucous membrane, as muscular and outer fibrous covering. They stated that the mucosa of the vagina consisted of numerous connective tissue fibers mingled with coarse elastic fibers. Papillae containing blood vessels were everywhere except in the depressions between the columnae rugarum. They also stated that diffuse adenoid tissue which sometimes assumed the form of lymphatic nodules was present in the mucosa. The muscular coat which in the lower region was quite prominent was separated indistinctly into an outer longitudinal and inner circular layer; the latter was, as a rule, poorly developed and occasionally entirely absent. The muscular coat was especially well developed anteriorly in the neighborhood of the bladder. The outer fibrous layer consisted of dense connective tissue loosely connected with adjacent structures.

In 1900 E. K. Dunham[10] described the muscular coat of the vagina as not clearly divisible into layers though the inner fibers were chiefly circular and the outer longitudinal. He regarded the latter as the true muscular coat of the vagina. Outside the muscular coat was a layer of areolar tissue connecting the vagina with its neighboring parts except at its posterior and upper part where it was covered with a serous membrane forming part of the peritoneum. In 1905 D. B. Hart and A. H. F. Barbour[11] quoted Henle, Breisky, von Preuschen and Lowenstein but did not evaluate the different theories of these observers. In 1910 W. Blair Bell[12] stated that the vagina was surrounded by an investment of muscular and fascial off-shoots containing vessels. Within this was a coat of involuntary muscle fibers running for the most part longitudinally but in the lower part concentrically as well. He presented two photomicrographs of the vaginal wall but the component parts were not labelled. In 1925 F. R. Bailey[13] described the vagina as having four coats, which he labelled from the outside inward as the fibrous, muscular, submucous and mucous. The fibrous coat consisted of dense connective tissue with many coarse elastic fibers, connecting the vagina with the surrounding structures. The muscular coat was indistinctly divided into an outer longitudinal and an inner circular layer, the latter being usually poorly developed or even absent. The submucosa was a layer of loose connective tissue especially rich in elastic fibers and blood vessels. Numerous large venous channels gave to the submucosa the character of erectile tissue. The mucous membrane consisted of a papillated connective tissue stroma of mixed fibrous and elastic tissue. The stroma usually contained diffuse lymphoid tissue and more rarely solitary nodules. In 1934 E. V. Cowdry[14] stated that the tunica propria often contained an abundance of lymphocytes and even lymph nodules. He added that the smooth muscle fibers were mostly longitudinal but that striated muscle formed a kind of sphincter at the opening.

In 1931 H. S. and R. J. Crossen[15] described the vagina as having three layers: an external connective tissue layer, a middle muscular layer and an inner mucous layer. The connective tissue served to connect the vagina to the adjacent organs. The muscular layer contained involuntary muscle fibers arranged in bundles without distinct strata. Some of the bundles were longitudinal, some transverse and some oblique. The muscle layer was thicker at the lower than at the upper end. The mucosa was attached to the muscular coat by a submucous layer of loose connective tissue which was very rich in interlacing veins. Bundles of muscular fibers around

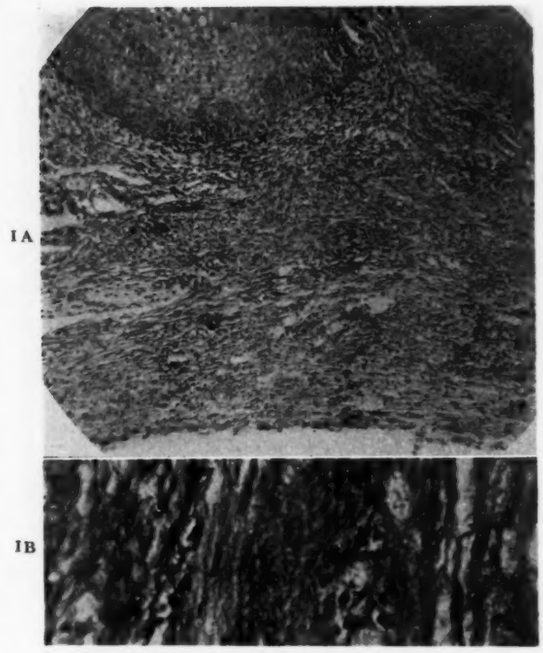


FIG. 1. Case I, four months' fetus. A, transverse section through the posterior vaginal wall at the middle third, showing squamous epithelium, vascular and fibrous substantia propria, the musculo-fibro-elastic layer and loose areolar tissue of the rectovaginal avascular space; elastic tissue stain × 135. B, a high power view of a similar area showing the three layers, epithelium, substantia propria and the musculo-fibro-elastic layer. In the substantia propria fibrous tissue, some elastic tissue and fairly prominent vessels are found. In the third layer there are some muscle fibers, fibrous tissue and elastic tissue which become more prominent in the outer portion where it encloses the nutrient vessels. The basal layer of vaginal epithelium is seen in the upper left hand corner; elastic tissue stain × 400.

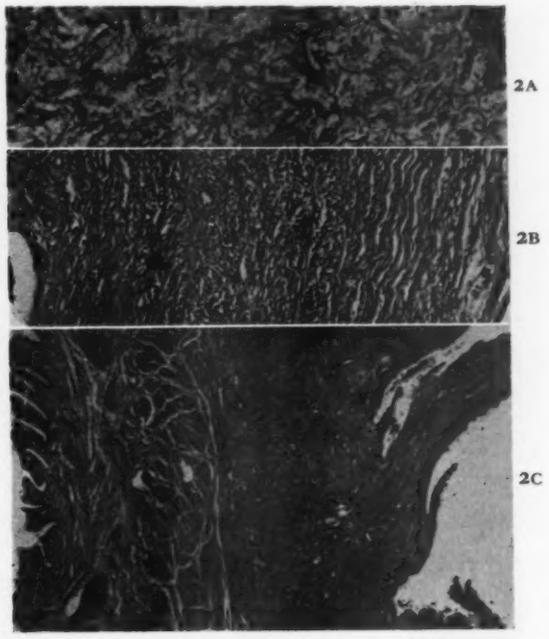


FIG. 2. Case II, six months' fetus. A, a high power view of the clitoris demonstrating erectile tissue with a marked vascularity and the involuntary muscle strands lying between the vessels; H and E stain × 90. B, transverse section through the posterior fornix, showing the fibrous and well vascularized wall, the scant muscle in the outer portion and scant elastica carrying the blood vessels. At the left is a small segment of the vaginal squamous epithelium; H and E stain × 90. C, transverse section through the perineal body, showing close fibrous fusion between the vagina and the rectum, a lack of elastica in the third layer and fairly prominent muscle; H and E stain × 15.

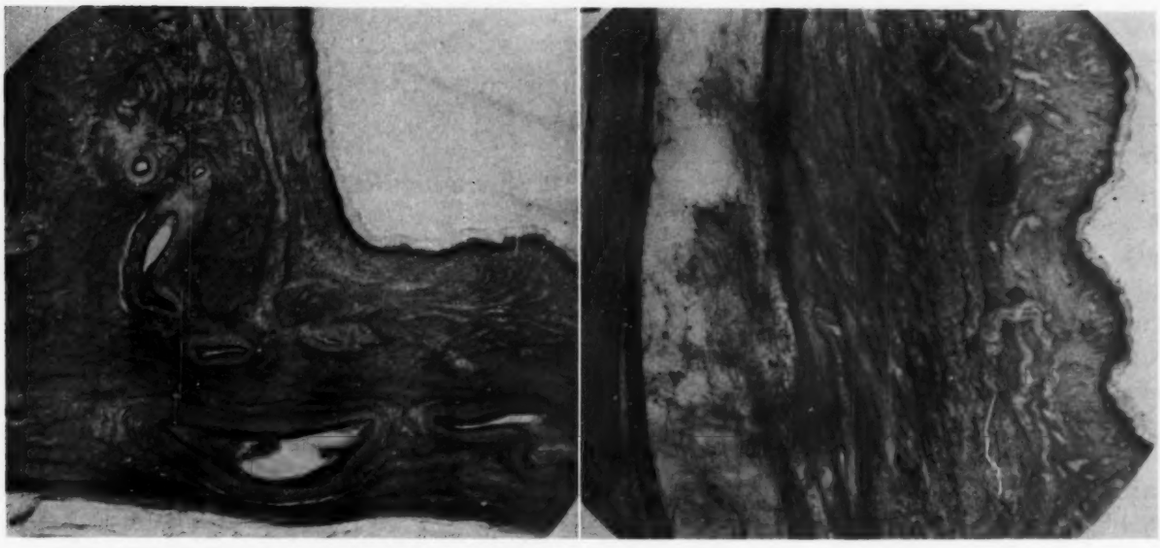
some of these veins formed a sort of vascular tissue.

In 1946 E. Novak[16] divided the vaginal wall into three layers: an outer fibrous, a middle muscular and an inner mucous. The fibrous coat was derived from the pelvic fascia while the muscular coat consisted mainly of an inner circular and an outer longitudinal layer. He also stated that normally there were no glands found in the vagina but, on rare occasions, a few glands were found in the fornix, usually aberrant cervical glands or gland-like tubules derived from the vestigial Wolffian duct. In 1947 A. H. Curtis[17] stated that the wall of the vagina was made up of three principal coats: an outer fibrous, a middle muscular and an inner mucous. The outer fibrous layer with the pelvic fascial and extraperitoneal tissue formed a dense sheath which clothed the vagina and connected it with surrounding structures—the bladder, urethra, colon and pelvic diaphragm. The muscular coat consisted of somewhat irregularly arranged groups of involuntary muscle fibers among which a considerable amount of connective tissue was distributed. This arrangement rendered the transition to the outer fibrous coat a very gradual one in which sharp delineation was lacking. The fibers in the muscularis were arranged chiefly in an inner circular and an outer longitudinal arrangement. In the tunica propria solitary lymph nodules were occasionally found. The deeper portion of the areolar tissue layer was permeated by

FIG. 3. Case VII, aged twenty years (three months' pregnancy). A, longitudinal section through the upper vaginal wall and anterior fornix showing the dense elastic component surrounding the vessels arising from the cardinal ligament and lying in the third layer of the vaginal wall. At this point there is partial fusion with the musculature components of the bladder in the trigonal region; elastic tissue stain × 30. B, longitudinal section through the posterior wall of the upper vagina below the fornix showing the compact vaginal wall and the elastic component around the vessels in the third layer. The rectal wall is loose in texture, the muscle layers being separated by wide areolar zones; H and E stain × 15; C, longitudinal section through middle portion of the posterior vaginal wall. In the vagina the elastica in the third layer is moderately prominent and the muscular component is scanty. The rectal wall is extremely thin and the muscle coats are separated by loose areolar tissue; H and E stain × 15; D, transverse section through the perineal body showing the close fusion between the two organs. The rectal mucosa is loosely attached by its sub-mucosa and muscular coats are completely fused with the vaginal wall; there is scanty elastica; H and E stain × 15.

a plexiform arrangement of vascular channels and contained scattered bundles of smooth muscle cells; hence it was described by some as a tela submucosa and by others as erectile tissue comparable to that found in the bulb of the vestibule.

In a previous communication[18] the general architecture of the vagina was presented in its relationships to the surrounding organs. The present communication deals with the detailed histologic anatomy of the vagina, with particular attention to its muscular and elastic components and their various anatomic arrangements at different levels. The influence of gravidity was studied in one specimen. The present study was based on the microscopy of fourteen specimens, each consisting of the entire vagina from the cervicovaginal junction to and including the anoperineal body and the fused urethrovaginal wall. Of these specimens, six were removed from the cadavers of fetus and infants; the remaining eight specimens were removed from adult cadavers. Only cadavers presenting no pelvic disease were selected. One specimen was removed from the body of a twenty year old patient who was three months' pregnant. The tissues were placed in fixing fluids and embedded in paraffin and celloidin. Some specimens were subjected to serial cross sections, some to serial saggital sections and others to both. The tissues were stained with hematoxylin and



4A 4B

4C

FIG. 4. Case IX, aged forty-one years. A, longitudinal section through the anterior fornix showing the outer layer of compact elastica associated with the vessels coming down from the cardinal ligament; elastic tissue stain × 15. B, longitudinal section through the upper third of the anterior vaginal wall and bladder showing the compact elastic component of the outer portion of the third layer; elastic tissue stain × 15. C, longitudinal section through the upper third of the posterior vaginal wall showing the heavy elastic component of the third layer carrying blood vessels; elastic tissue stain × 15.

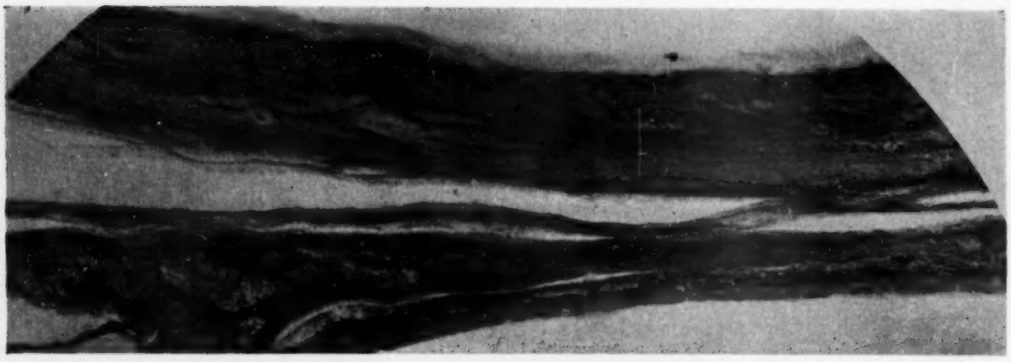
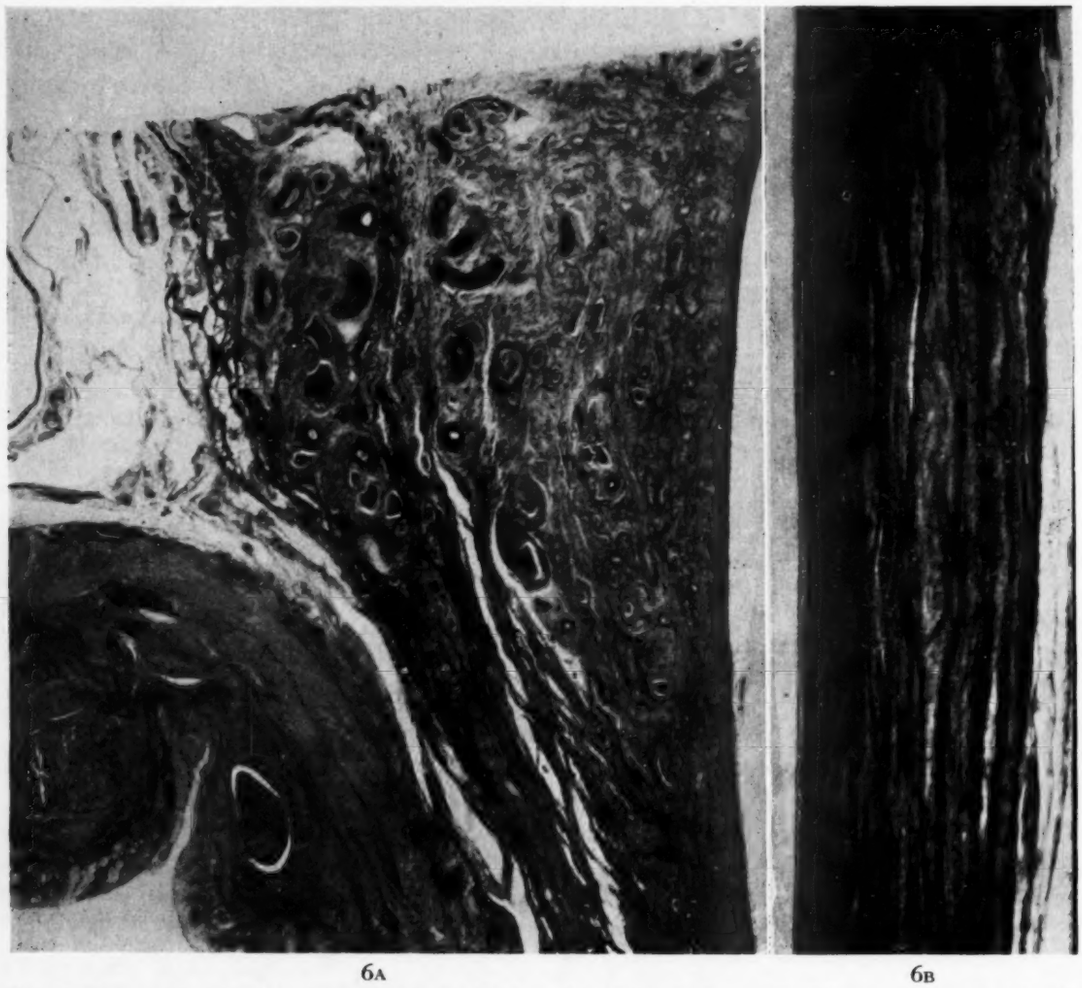


FIG. 5. Case XII, aged forty-three years. Longitudinal section through the cul-de-sac of Douglas showing the compound layer of elastica in the outer portion of the third layer which becomes scantier, more caudad. The peritoneum of the cul-de-sac is in the lower part of the picture, the vaginal mucosa in the upper. The upper portion of the section is on the right; elastic tissue stain × 15.



6A 6B

FIG. 6. Case XIII, aged sixty years. A, longitudinal section through the cardinal ligament, anterior fornix and bladder showing the close fusion of the cardinal ligament to the upper vaginal wall and the heavy elastic component which encloses the vessels sweeping down into the outer portion of the vaginal wall. The anterior peritoneal fold is included. The vaginal mucosa is flat and atrophic; elastic tissue stain × 6. B, longitudinal section through the middle portion of the posterior vaginal wall showing the atrophic mucosa and a compact wall consisting predominantly of elastica; elastic tissue stain × 30.

eosin, Verhoff's elastica stain and von Giesson's connective tissue stain. (Figs. 1 to 6.)

Results of this study show that the vaginal wall can be divided into three layers—the epithelium, the substantia propria and the musculo-fibro-elastic layer. The stratified squamous epithelium is similar in all ages. The vaginal wall lacks glands and lymphatic tissue. In the fetus and infant the rugae are large and prominent. They tend to become flattened in adult life and are almost completely obliterated in the senile period.

TABLE 1

Specimen	Age	Color	Parity
1	4 mo. fetus	White	
2	6 mo. fetus	White	
3	8 mo. fetus	White	
4	9 mo. fetus	White	
5	6 mo. infant	White	
6	12 mo. infant	White	
7	20 yr.	White	
8	31 yr.	Colored	Nullipara
9	41 yr.	White	Nullipara
10	42 yr.	Colored	Para VIII
11	42 yr.	Colored	?
12	43 yr.	White	Nullipara
13	60 yr.	White	Multipara
14	67 yr.	White	Multipara

The substantia propria consists of a fibro-elastic network enclosing the arteries, veins and nerves. The elastica has both fine and coarse fibers. It is similar in architectural pattern at all ages and is free of intrinsic muscle fibers. In only one specimen (from the four months' fetus) were there a few involuntary muscle strands in the distal portion of the vaginal wall which were finger-like projections of the third vaginal layer. There is no suggestion of erectile tissue in the architectural pattern as has been described by other observers.

The third layer of the vagina is formed of the musculo-fibro-elastic tissue. It is a compact structure not separable into individual layers. Anteriorly, it is intimately fused with the urethra from the base of the bladder to the urethral meatus. Posteriorly, it is intimately fused with the anoperineal body and is separated from the rectal musculature by areolar tissue. Occasionally fine elastic fibrils enter the loose areolar tissue from the outer surface of the vaginal wall. The fibrous component of the third layer is interwoven with the other two elements. Superiorly and inferiorly it forms the principal component where the vaginal wall fuses with the anoperineal body and the cervix, respectively. That portion of the vaginal wall which fuses with the cervix is almost completely devoid of muscle. The musculature of this third layer of the vagina is involuntary in type and relatively scant, consisting of a maximum of 15 per cent of the total structure of the entire vaginal wall. There is no definite arrangement into a circular and a longitudinal layer. The muscle fibers are almost always irregularly disposed into circular, oblique and longitudinal strands without any definite pattern.

Only in the four months' fetus was there a suggestion of a definite pattern. In this specimen a circular layer of muscle was found at all levels of the vaginal wall and at the cervicovaginal junction there was a longitudinal layer lying internally.

At all ages the muscle fibers become lost inferiorly in the tissues surrounding the introitus and superiorly in the outer portion of the fibrous stroma of the cervicovaginal junction. In the young adult the muscle is firmer in the middle third of the vagina, posteriorly and laterally. The muscle fibers are lost anteriorly in the compact urethrovaginal wall. With advancing age atrophy sets in and in the senile period there is almost a complete absence of muscle fibers. In the specimen from the three months' pregnant woman there was a suggestion of muscular hypertrophy.

The elastic element of the third layers, its most important component, is intimately interwoven with other elements. It is definitely related to the cardinal ligament. As the vessels descend into the vagina, they carry with them a rich supply of elastic fibers which become attenuated as they approach the lower portion of the vagina. In the upper portion of the vagina

they condense into a compact band-like structure, first evident in the six months' fetus, although they remain an integral part of the vaginal wall. There is no suggestion of a separate layer of elastica distinct from the other component parts of the third layer. In specimens from the older women in which there was atrophy of the muscular component, the outer elastica element appeared relatively more prominent.

CONCLUSIONS

The vagina is made up of three layers: (1) an inner mucous layer consisting of a stratified squamous epithelium, (2) substantia propria which contains fibrous tissue, fine and coarse elastic fibers surrounding nutrient vessels and is devoid of muscle fibers and (3) a layer composed predominantly of elastic tissue, a moderate amount of fibrous tissue and a few scattered muscle bundles.

There is no definite layer of muscle in the vagina; the few muscle fibers present are circular, oblique and longitudinal, the greatest amount, found in the middle third of the vagina, for the most part constitutes only 15 per cent of the entire vaginal wall.

The elastic tissue element is the most important component of the vaginal wall. It is more compact and abundant at the base of the cardinal ligament, following the blood vessels as they approach the cervicovaginal area. As the elastica descends into the vagina, it diffuses and intermingles with the fibrous tissue and muscle fiber elements and also forms a peripheral vaginal wall band.

There are no erectile tissue elements, no lymphatic nodules and no glands in the vaginal wall.

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CESAREAN SECTIONS—1937 TO 1946*

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SINCE the introduction of cesarean section into the armamentarium of the obstetrician, there have been many improvements made in technic which have greatly increased the safety of the operation. More recently the use of chemotherapy and antibiotics as well as improved preparation of the patient for operation have decreased the risk of the procedure to the patient even further. It seems wise to re-evaluate our statistics in the light of these changes.

TABLE I
INCIDENCE OF CESAREAN SECTION

Period	No. of Deliveries	No. of Sections	Percentage of Incidence
Through 1936.....	40,288	1,113	2.7
1937–1941.....	14,092	517	3.6
1942–1946.....	22,246	924	4.1

We have reported in two previous papers our statistics in cesarean sections from the time of the opening of our hospital in 1906 through 1936. This present report deals with sections (abdominal hysterotomy, twenty-six weeks or over) done in the ten years from 1937 through 1946. Whenever it has seemed to be of value, we have divided these operations into two five-year groups; the later five-year group is representative of our experience with the free use of chemotherapy, antibiotics and blood plus the use of extraperitoneal cesarean section when indicated.

Incidence. In the ten years of our study there were 36,338 deliveries of which 1,441 were cesarean sections, an incidence of 3.96 per cent. (Table I.) Comparing this with our previously reported incidence, it is apparent that there is a slow but obviously continued tendency toward an increase in the incidence of cesarean sections. This somehow is to be expected both as a result of the marked increase in safety of the operation as well as the broadening of the indications. Nevertheless, it is wise not to allow this trend to get out of hand as the degree of safety is in no way comparable to the safety of the normal vaginal delivery. One should always bear in mind, too, the cumulative risk of cesarean section as it is not alone the risk of the first section but of the second and third and even the fourth.

TABLE II
INDICATIONS FOR SECTION

	No. of Cases	Per cent	Per cent 1932–1936	Per cent 1908–1931
Repeat section.....	376	26.1	23.1	
Disproportion.....	294	20.4	35.7	
Toxemia.....	144	10.0	8.4	5.0
Inertia.....	133	9.2		
Placenta previa.....	118	8.2	6.3	2.6
Abnormal presentation.....	101	7.0		
Elderly primipara.....	88	6.1		
Previous stillbirth(s).....	78	5.4		
Previous gynecologic operation.....	73	5.1		
Cardiac.....	54	3.7 (7.0)* (1.9)†	6.3	2.5
Fibroid uterus.....	49	3.4		
Sterility.....	37	2.6		
Fetal distress.....	22	1.5		
Diabetes.....	19	1.3		
Ablatio placenta.....	14	1.0		
Obstructing tumors.....	12	0.9		
Ruptured uterus.....	2	0.1		
Miscellaneous.....	18	1.3		

* 1937–1941
† 1942–1946

Indications. As in our previous report the repeat cesarean represents about one-fourth of our entire group. (Table II.) At the present time it is still our practice to follow the dictum, "once a cesarean, always a cesarean." It probably will remain our practice until such time as there is convincing proof of a marked reduction in the incidence of ruptured uteri in subsequent

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labors—not only the immediate but the remote labors. We are well aware of the difference of opinion on this subject. When we are able to predict with accuracy the behavior of the scar in the uterus, we will probably change our attitude.

TABLE III
MATERNAL MORTALITY

	No. of Cases	No. of Deaths	Per cent of Mortality
Through 1936....	1,113	33	2.95
1937–1946.....	1,441	13	0.9
1937–1941.....	517	8	1.54
1942–1946.....	924	5	0.54

The further increase in the importance of placenta previa and toxemia as indications for cesarean sections is to be noted. With regard to the former, a previously published report demonstrated the superiority in maternal result of cesarean section over every other type of treatment except simple rupture of membranes. As for toxemia, it has been our practice to terminate the pregnancy when we are unable to control progression of symptoms of preeclampsia by the usual methods. In the primipara, when the cervix is long, uneffaced and does not allow of easy rupture of the membranes, it becomes necessary to empty the uterus abdominally.

It is interesting to note the relative turnabout in our practice with regard to cardiac disease in the mother. For a while there was an increasing trend of cardiac disease as an indication for section until in the years 1937 to 1941 it reached its peak of 7.0 per cent of the cases sectioned. In the last five years it has dropped to 1.9 per cent and will probably drop even further as a result of the recently demonstrated tendency of cardiacs to tolerate labor at term well.

Maternal Mortality. It is a consideration of the maternal mortality that is by far the most important desideratum when one considers cesarean section. (Table III.) In our series of 1,441 we had thirteen deaths or a rate of 0.9 per cent. On the other hand, in the last five years we have had only five deaths or a mortality rate of 0.54 per cent. This we believe is representative of our present mortality rate in cesarean section. It is exceedingly low yet we believed that if improvement is to occur, a thorough study of these thirteen deaths must be made.

CASE HISTORIES

CASE I. A thirty-seven year old woman, No. AA41162, 1937, gravida II, para 0, had a classical section done under general anesthesia after seven hours of irregular pains, with membranes intact. This patient had a history of a fourteen-year sterility following an ectopic pregnancy. She died on the fifth postoperative day of bronchopneumonia and Staphylococcus aureus hemolyticus sepsis.

CASE II. A twenty-four year old woman, No. AA45870, 1938, gravida III, para 0, had a low flap section done under general anesthesia for disproportion after thirty-five hours of labor and ruptured membranes which had existed for eleven hours. Signs of bronchopneumonia developed on the first postoperative day. Sulfanilamide was given from the fourth day on; a blood transfusion was also given. She died of sepsis on the eighth postoperative day.

CASE III. This patient, No. AA47711, 1939, gravida II, para 0, had multiple fibroids, breech and an android pelvis. Low flap section and myomectomy was done under general anesthesia after a few hours of irregular pains; membranes had been ruptured six hours. Her temperature varied from 100 to 101°F. from the first to ninth day; it became normal after the ninth day. The patient expired suddenly on the sixteenth day after collapsing in the bathroom. Death was ascribed to a pulmonary embolus; no autopsy was performed.

CASE IV. A thirty-two year old woman, No. AA48184, 1939, gravida VI, para II, was seen who weighed over 200 pounds, was short and very obese. Her first delivery was by craniotomy; second delivery was by version after forceps failed. Labor lasted eight hours. A breech extraction failed after both feet were in the vagina. Porro section was done under general anesthesia several hours later. Blood was given postoperatively. The baby weighed

12 pounds and 13 ounces. The mother died of postoperative shock within twenty-four hours.

CASE V. A thirty-one year old woman, No. AA48368, 1939, gravida 1, para 0, was admitted when thirty weeks pregnant, with symptoms of ruptured uterus. She gave a history of multiple myomectomies eighteen months before. Classical section (and transfusion) was done under general anesthesia. She died seventy-two hours postoperatively of bronchopneumonia due to aspiration. The baby, weighing 3 pounds and 1 ounce, died.

CASE VI. A thirty-five year old woman, No. AA60383, 1941, gravida VI, para II, had an repeat elective reparative classical section done under single-shot spinal anesthesia (150 mg. procaine). Her blood pressure was 140/96 on admission but fell to 65/0 as the uterus was incised. The patient died of spinal shock as the uterus was being closed.

CASE VII. A twenty-seven year old woman, No. AA60553, 1941, gravida 1, para 0, had a low flap section for disproportion under local anesthesia after eight and a half hours of pains; membranes were intact. A transfusion of 500 cc. was given once in the puerperium. Sulfathiazole was begun on the seventh postoperative day. She died of sepsis on the thirteenth postoperative day.

CASE VIII. A thirty-three year old woman, No. 247944, 1941, gravida 1, para 0, had an elective classical section performed under general anesthesia for obstruction due to a cervical fibroid. She was explored on the eighth postoperative day for an obstructive ileus. Adhesions and a pus pocket were found. Sulfa was given intravenously and also was left in abscess cavity. A total of 3,500 cc. of blood were given. She died of sepsis on the eighteenth day.

CASE IX. A thirty year old woman, No. 261506 (General Service Case), 1943, gravida II, para 1, was seen at term. After a relatively short labor, with membranes intact, she became fully dilated. The vertex was unengaged due to a large cyst impacted in the pelvis. An attempt to push the cyst out of the pelvis under anesthesia with the patient in Trendelenburg was unsuccessful. Low flap section under general anesthesia and a left salpingo-oophorectomy for a large adherent cyst were performed. While walking around on the twelfth day, she died suddenly of a large pulmonary embolus proved by autopsy.

CASE X. A thirty-five year old woman, No. AA79400, 1944, gravida II, para 1, had rheumatic heart disease. She gave a history of a previous section and having been hospitalized for decompensation for twenty days prior to time of section. Classical section and sterilization under local anesthesia were done at thirty-six weeks because of mild labor pains. She died on the tenth postoperative day of an unrecognized staphylococcus sepsis.

CASE XI. A twenty-three year old woman, No. AA88873, 1945, gravida 1, para 0, with a congenital cardiac condition was seen. Elective classical section and right salpingo-oophorectomy for a cyst was done under fractional spinal anesthesia. She died suddenly on the second day after a very short period of marked dyspnea and cyanosis and was signed out as an embolic death. No autopsy was done.

CASE XII. An eighteen and one-half year old gravida 1, para 0, No. AA97283, 1946, had an elective classical section done under fractional spinal anesthesia (50 mg. procaine) for cardiac disease. She went into shock and died on the table immediately after the baby was extracted from the uterus. She was signed out as a spinal death.

CASE XIII. A thirty-seven year old woman, No. 298685 (General Service Case), 1946, gravida II, para 1, was seen at term. She had had a radical mastectomy for carcinoma, with metastases to bones, spine and lungs. She had refused interruption of pregnancy at four and a half months. Elective low flap section was done under local anesthesia. The patient died on second postoperative day of pneumonia.

COMPARISON OF RESULTS

It seems appropriate to compare our results in elective and non-elective cases. (Table IV.) As a result of our ten-year study it would seem that elective section (before the onset of labor or rupture of membranes) is to be preferred to non-elective section. However, if we divide our sections into five-year groups we find almost identical mortality rates for elective and non-elective cases. (Table V, Fig. 1.)

By referring to Table VI it is noted that the marked reduction in mortality in the last five years is entirely due to the almost complete elimination of sepsis as a cause of death. As a matter of fact the only death

due to sepsis (Case x) in the last five years was due to the fact that a staphylococcus septicemia was unrecognized until it was too late to affect the outcome.

Recently there has been mention of the greater risk entailed in repeat sections. Our own figures seem to indicate about half the maternal mortality for repeat sections as for primary sections. (Table vii.) The two deaths in repeat sections are represented by Case vi due to spinal anesthesia and Case x due to unrecognized sepsis.

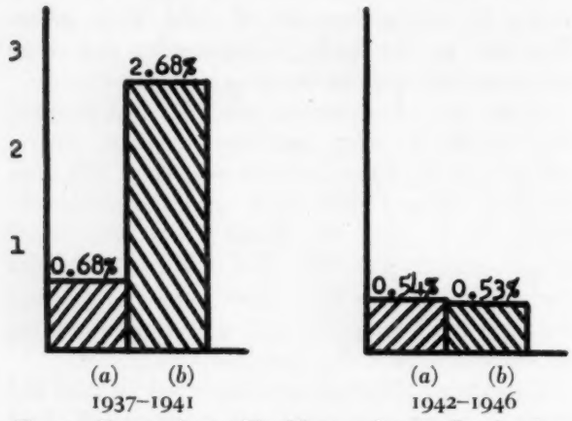

Fig. 1. Comparison of incidence of mortality in elective and non-elective cases; (*a*) elective; (*b*) non-elective.

Table iv
COMPARISON OF MATERNAL MORTALITY IN ELECTIVE AND NON-ELECTIVE CASES

	No. of Cases	No. of Deaths	Per cent of Deaths
Elective	843	5	0.59
Non-elective	598	8	1.3

Table v
COMPARISON OF INCIDENCE OF MORTALITY IN ELECTIVE AND NON-ELECTIVE CASES (IN FIVE-YEAR PERIODS)

	Elective Cases			Non-elective Cases		
Five-year Period	No. of Cases	No. Deaths	Per cent Deaths	No. of Cases	No. Deaths	Per cent of Deaths
1937–1941	292	2	0.68	224	6	2.68
1942–1946	551	3	0.54	374	2	0.53

A comparison of maternal mortality with relation to the type of section would seem to favor the low flap section and the extraperitoneal section as indicated by the mortalities even in the second five years. (Table viii.) However, when it is considered that only one of the deaths was due to sepsis (and that one in an elective section), a comparison is not justifiable. This is not to be interpreted as a point for complete disregard of the type of section as will be indicated in a discussion of morbidity.

Table vi
CAUSES OF DEATH

	Total	1937–1941	1942–1946
Sepsis	5	4	1
Pulmonary embolus	3	1	2
Spinal anesthesia	2	1	1
General anesthesia	1	1	0
Pneumonia (carcinoma)	1	0	1
Shock (?)	1	1	0

Three of our deaths were due to anesthesia. One occurred as a result of aspiration pneumonia in a patient (with previous multiple myomectomies) who was given general anesthesia shortly after the patient ruptured her uterus during her seventh month of pregnancy. This complication might have been avoided by gastric lavage prior to induction of anesthesia. The other two deaths occurred as a result of spinal anesthesia.

Table vii
COMPARISON OF MATERNAL MORTALITY IN REPEAT SECTIONS AND PRIMARY SECTIONS

	No. of Cases	No. of Deaths	Per cent of Deaths
Repeat sections	376	2	0.53
Primary sections	1,065	11	1.03

Figure 2 indicates the trend in our anesthesias. The great rise in spinal anesthesia resulted from the introduction of fractional spinal anesthesia. One of the deaths occurred from a single dose of spinal anesthesia before the use of fractional doses.

One death resulted from a 50 mg. fractional dose of procaine. No deaths resulted from local anesthesia in this group. We believe that a word of caution is indicated in the use of spinal anesthesia. While we believe that the fractional method of introduction of the anesthetic agent in the subdural space is to be preferred to the single dose method, it is not without its dangers. At the present time we use the precaution of using very small doses (an initial dose of 25 mg.) and of having each patient receive intravenous fluids before, during and after the use of the spinal. The ready availability of a mechanical respirator will also prove of value in the exceptional case. Local anesthesia is still the anesthetic of choice in the vast majority of cases.

Three of our deaths were due to pulmonary embolus (clinical, only one autopsy report). (Table IX.) It was very enlightening to find that two of these patients had an oophorectomy for ovarian cyst at the time of operation and one had a myomectomy at the time of section. When one considers that only forty of our patients had either a myomectomy or oophorectomy, this represents a high mortality. The tremendously increased vascularity of these tumors in gestation is well known and phlebothrombosis of the distended veins upon removal is to be expected. It would seem to us that it would be important not to do myomectomy at the time of a cesearean unless it is necessary as part of the procedure. However, when it is imperative that this operation be done or when oophorectomy for cyst is performed, it is suggested that the patient be heparinized in the postoperative period to prevent embolization.

Thus, while it may seem that 0.54 per cent maternal mortality represents an almost irreducible surgical minimum, we believe that closer attention to our anesthetic problem together with anticoagulation therapy in cases in which myomectomy or oophorectomy is done at time of operation should further reduce this rate.

Sterilization usually is done at the second or third section in our hospital. In this series it was done in 347 cases.

TABLE VIII

COMPARISON OF MATERNAL MORTALITY IN RELATION TO TYPE OF SECTION

	Classical Section			Low Flap Section			Extraperitoneal			Porro		
	No. of Cases	No. of Deaths	Per cent of Deaths	No. of Cases	No. of Deaths	Per cent of Deaths	No. of Cases	No. of Deaths	Per cent of Deaths	No. of Cases	No. of Deaths	Per cent of Deaths
1937–1941	247	4	1.6	194	3	1.5	59	0	0	15	1	6.6
1942–1946	292	3	1.0	469	2	0.42	139	0	0	20	0	0

TABLE IX

PROCEDURES (OTHER THAN TUBAL LIGATION) DONE AT TIME OF SECTION AND RELATED MATERNAL MORTALITY

	No.	Deaths
Myomectomy	30	1*
Oophorectomy	10	2*
Section hysterectomy	35	1
Repair of ventral hernia	4	0

* All deaths due to pulmonary embolus.

TABLE X

MORBIDITY

	No. of Cases	No. Morbid	Per cent Morbid
Through 1936	1,113	505	46.5
1937–1946	1,441	491	34.0
1937–1941	517	259	50.0
1942–1946	924	232	25.1

As a concomitant of mortality one must always consider the morbidity of the patients surviving. (Table x.) For the ten-year period our morbidity was 34.0 per cent. The lack of significance of this figure is apparent when we break the figures up into two five-year periods and it is seen that the morbidity for the period 1937 to 1941 was no different than the morbidity for the previous years, whereas the morbidity for the period 1942 to 1946 was practically halved. A further indication of this trend is seen by comparing the number of patients with severe morbidity (temperature elevation beyond six days after the first seventy-two hours). It is noted that the drop in the last five years is almost to 25 per cent of the former figure. (Table xi.)

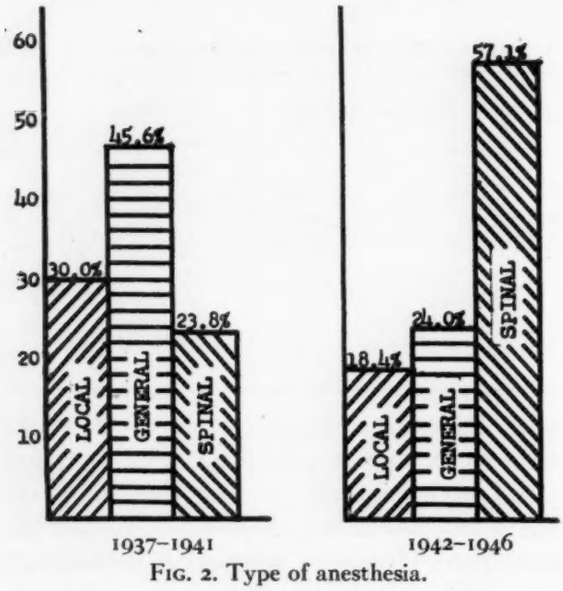

FIG. 2. Type of anesthesia.

TABLE XI
INCIDENCE OF SEVERE MORBIDITY

	No. of Cases	No. Severe Morbid	Per cent Severe Morbid
1937–1941	517	40	7.7
1942–1946	924	17	1.8

In previous reports it was always apparent that there was a reduced morbidity associated with low flap section as compared with classical section. This same trend seems to be present for the first five years of our series (Table XII) but entirely disappears for the second five years. However, this does not represent the complete picture as can be deduced from the fact that many more of our patients who had low flap sections had longer periods of labor and more prolonged periods of existence of membranes. This is even more applicable to our group of extraperitoneal sections. (Figs. 3 and 4.)

TABLE XII
COMPARISON OF MORBIDITY OF ELECTIVE CASES IN CLASSICAL AND LOW FLAP SECTIONS

	Classical Sections			Low Flap Sections		
	No. of Cases	No. Morbid	Per cent Morbid	No. of Cases	No. Morbid	Per cent Morbid
1937–1941	203	95	46.8	80	31	38.7
1942–1946	253	53	20.9	277	56	20.2

TABLE XIII
FETAL MORTALITY

Total number of babies born	1,452 (11 sets of twins)
Total fetal mortality	77 or 5.3%
Non-viable infants	3
Monstrosities	2
Viable fetal mortality	72 or 4.9%
Prematures (less than 36 weeks)	67
Premature deaths	26 or 38.8%
Corrected fetal mortality (corrected for non-viability and prematurity)	48 or 3.4%

We note no change in our results of fetal mortality over the years. (Table XIII.) Our uncorrected mortality (stillbirths and neonatal deaths) is 5.3 per cent. When corrected for prematurity and nonviability, our figure is 3.4 per cent, almost identical with our previously reported figure of 3.5 per cent. Even more significant is the fact that 39 per cent of the prematures were stillborn or died in the neonatal period. There may be a reduction obtained in the incidence of prematurity by the recently accepted expectant treatment for placenta previa.

SUMMARY AND CONCLUSIONS

1. There is a slow but definite increase in the incidence of sections. In our hospital

the figure has risen from 2.7 per cent to 4.1 per cent in the last ten years. A similar increase has been observed in many of the large obstetrical clinics throughout the country. The reasons are to be found in the present day increased safety of the operation and in a broadening of the indications. More patients with placenta previa and progressive pre-eclampsia are sectioned today than five or ten years ago while the incidence of cardiacs managed by section is definitely on the decrease. We believe that most cardiacs can and should be allowed to deliver vaginally unless a definite obstetrical indication for section is present. These patients should be well sedated during the active phase of labor and have the second stage shortened. It is not necessary or desirable to subject a cardiac to section merely for the sake of sterilizing

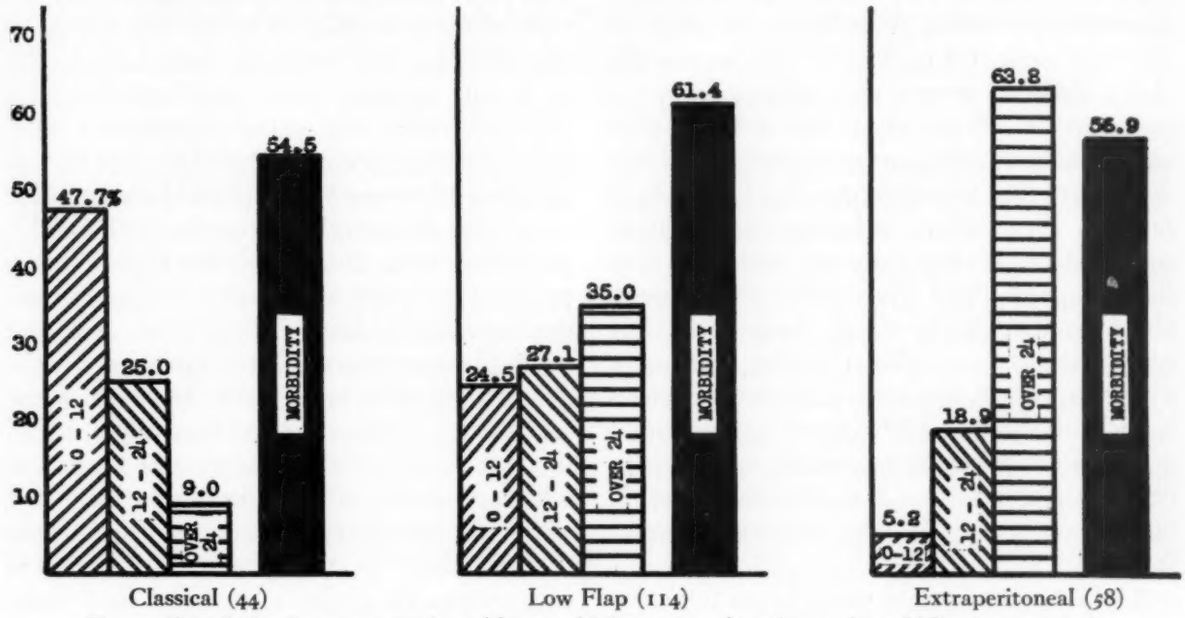

FIG. 3. Correlation between number of hours of labor, type of section and morbidity (1937–1941).

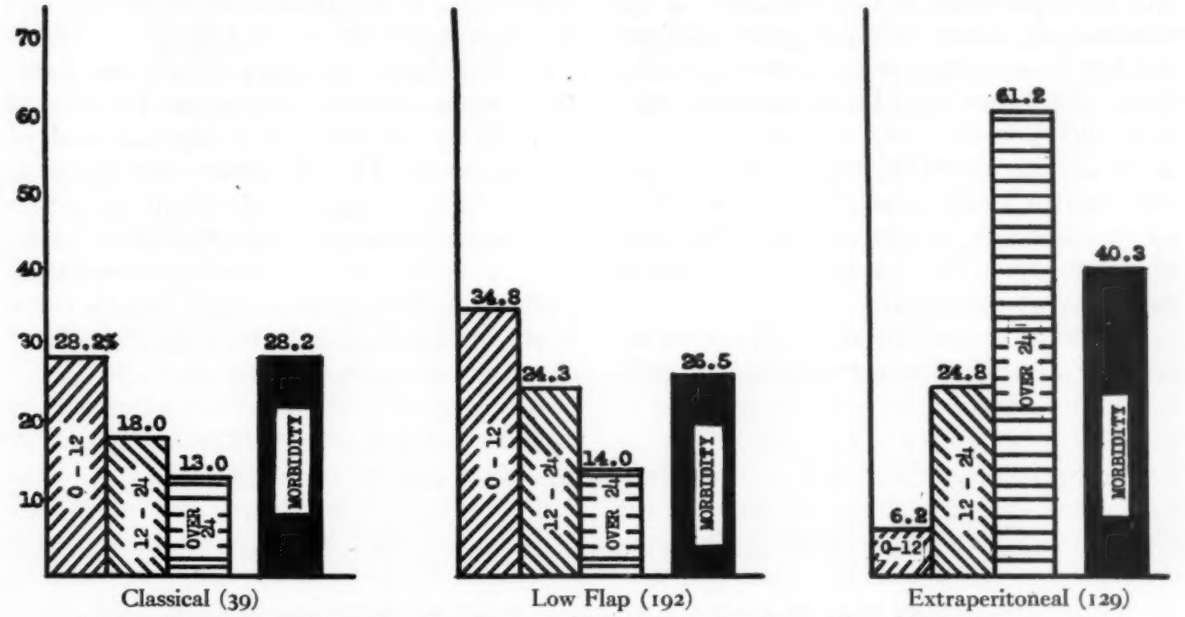

FIG. 4. Correlation between number of hours of labor, type of section and morbidity (1942–1946).

her. This, when desired, can be done in the early puerperium with much greater ease and safety.

2. Maternal mortality during the last five years is 0.54 per cent as compared to 1.54 per cent, the mortality figure for the first five years. The maternal morbidity likewise has fallen from 50.0 per cent to 25.1 per cent. Of particular interest is the sharp drop in severe morbidities from 7.7 per cent to 1.8 per cent. All of these considerable reductions in mortality and morbidity are due to a group of fairly constant factors. First, there is better preoperative preparation of the patient, including the liberal use of blood when indicated; second, there is the early (and frequently the prophylactic) use of antibiotics and sulfa drugs; and last, the extraperitoneal section in indicated cases. The almost complete disappearance of sepsis as a cause of death in our last 924 sections is a striking example of the efficacy of the aforementioned factors.

3. The mortality in elective sections for the entire ten-year period is about one-half (0.59 per cent) of the mortality for the non-elective cases (1.3 per cent). During the last five years, however, the mortality figure of 0.54 per cent for all sections (elective and non-elective) is practically the same as the mortality figure of 0.59 per cent for the elective sections of the entire ten-year period. The reasons are the same as those given for the general decline of mortality and morbidity.

4. The three anesthesia deaths reported must be considered as preventable mortalities. Two of the three were due to spinal anesthesia and one to general anesthesia. While there has been a sharp increase in the use of spinal anesthesia in recent years, especially since the introduction of fractional spinal, we should be cognizant of the fact that any form of spinal anesthesia entails a certain risk, even in the hands of the well trained medical anesthesiologist. It is our opinion that local anesthesia is still probably the safest anesthesia and, with a little time and patience, can be administered to most patients to be sectioned.

5. The three embolic deaths are quite instructive and, therefore, worthy of comment. Two were associated with salpingo-oophorectomy for ovarian cyst and one with myomectomy. Three embolic deaths in a group of forty patients in whom some additional procedure (other than tubal ligation) was done at the time of section is a high mortality and is probably associated with the marked vascularity that these tumors show in the presence of a term pregnancy. It is quite possible that postoperative anticoagulant therapy of such cases may, in the future, decrease the incidence of death due to embolus.

6. The fetal mortality of 5.3 per cent, even when corrected to 3.4 per cent, is still as high as the previously reported one of 3.5 per cent. This is rather discouraging, particularly in view of the sharp reduction of maternal mortality and morbidity. Possibly a policy of temporizing in selected cases of placenta previa until a viable fetus is obtainable may help to reduce the fetal mortality to some extent.

PNEUMATOSIS INTESTINALIS*

ROENTGEN DIAGNOSIS AND SURGICAL MANAGEMENT

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PNEUMATOSIS intestinalis is so little known that when it occurs it presents a challenge to diagnosis and management. The variations in degree and type, the discrepancy between the sparse clinical and the extensive operative findings, the diversity of pathologic conditions all invoke the exercise of keen judgment based on an appreciation of the fundamental nature of the disease.

Since pneumatosis is defined as the presence of gas in an abnormal location in the body, the diffuse spread of gas into the intestinal tissues is labeled pneumatosis intestinalis. The arrangement of this gas in cyst-like accumulations within the wall of the intestine and its mesenteric attachments may be designated as pneumatosis cystoides intestinalis. This entity has been reported in the literature as "gas cysts of the intestine," "emphysema intestinorum," "cystic pneumatosis of the bowel" and "pneumatosis cystoides intestinorum hominis."

It is generally agreed that Bang in 1876 published the initial description of a human case of pneumatosis intestinalis. Prior to that data an analogous condition occurring in animals, notably swine, had been recognized.[14] The first report in the American literature was by Finney[6] in 1908. The most recent review was published in 1940 by Jackson[8] who collected all the previous cases and, adding his own, brought the total to 172. Of these, eleven were children and one hundred sixty-one were adults. Since that date, there have been numerous (at least seventeen) reports in the foreign literature but only two contributions from the United States.[9,10]

Roentgenologic diagnosis was lacking in American reports until the case presented by Lerner and Gazin[9] in 1946 which, however, had no operative confirmation. The first preoperative roentgenologic diagnosis that we have been able to find was reported by Baumann-Schenker[1] in 1939. This author states that Von Mengis (1934) cited two previous preoperative roentgenologic diagnoses. He also declares that a few other preoperative diagnoses are extant but gives no references. The case we are presenting is the first instance in American literature to be diagnosed preoperatively and confirmed both by surgery and histologic study.

ETIOLOGY

Three major hypotheses have been advanced to explain the production of this entity:

1. *Neoplastic.* Bang and Finney[6] believed that the process was a distinct type of tumor, the cells of which were capable of forming gas. This concept has never received histopathologic substantiation. The spontaneous disappearance of intestinal emphysema in many proved cases also serves to refute this theory.

2. *Infection.* The majority of bacteriologic studies in man have failed to demonstrate bacteria[13,19] and the analysis of gas from the cyst-like areas has disclosed the presence of oxygen,[14] a finding not likely

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to be associated with a bacterial origin of the gas. The microscopic picture is not entirely consistent with an infectious process. No report has been found in the literature with respect to the part that fungi or parasites may play in this entity.

3. *Mechanical.* Most authors[4,8,14,19] postulate a break in the continuity of the mucosa with escape of intestinal gas into and through the intestinal wall. Analysis of the cases previously reported in the literature reveals that the majority are associated with some form of intestinal obstruction, predominately pyloric stenosis. An attempt to reproduce this entity in experimental animals by injecting air submucosally has resulted in escape of the gas into the perivascular, serosal and mesenteric lymphatics, forming cysts in the mesentery and retroperitoneal tissues but not in the local bowel wall.[4] Pertinent evidence includes an autopsy described by Botsford and Krakower[4] in which a wedge-shaped distribution of emphysema was traced to reveal its apex at the mucosa.

The absence of pneumatosis intestinalis in the vast majority of cases of acute or chronic bowel obstruction or in cases of enteritis with partial bowel obstruction has caused hesitancy in acceptance of a purely mechanical basis for intestinal emphysema. However, increased intraluminal pressure and some degree of obstruction have been too frequent to be disregarded and appear to provide the logical explanation for the initial passage of gas through the mucosa.

We suggest that the spread of the gas into the lymphatic system results in obstruction to lymphatic drainage. The development of inflammatory changes then prevents adequate absorption of the gas from the bowel wall. In those instances in which the factors of lymphatic obstruction and inflammatory change are minimal or reversible the condition resolves itself following surgical rectification of the bowel obstruction. Should the obstruction persist and the inflammatory changes become chronic, the process becomes progressively worse.

PATHOLOGY

The gross appearance has been described as resembling "massive colloid carcinoma,"[15] "beginning echinococcus cyst"[6] and "hydatid mole cysts."[12] As the gas penetrates the bowel wall and comes to lie in the subserosal plane it may dissect between the layers of the mesentery and may pass into the retroperitoneal space. In this manner it is possible for the gas to reach the subdiaphragmatic region and conceivably enter the mediastinum. The distribution of the cysts may be patchy with skip areas or be well localized. There is a tendency for the gas to accumulate into cyst-like formations which are "massed together like soap bubbles in a basin of suds."[6] The cysts may vary from microscopic size to 3 cm. or more in diameter. The loculations may have their shape changed when the gas is forced along tissue planes by extrinsic pressure. The dissection of the gas into the submucosal region may cause the mucosa to encroach on the lumen of the bowel to such a extent as to produce obstruction.[14] It should be emphasized that the gas is exclusively "extraperitoneal" unless a break in the peritoneum ensues.

In the majority of cases the pneumatosis has been localized to the terminal ileum. In some instances it has involved the stomach, duodenum[1] and colon.[21] Analysis of the gas contained within the cyst has revealed that it is odorless and noninflammable.[6] A few chemical analyses have been made which suggest that the content of the cysts is a gas closely resembling atmospheric air.[13,14]

Microscopically, the tissue consists of numerous cysts without obvious content and devoid of a demonstrable epithelial or endothelial lining.[4,8] Several investigators[14] have thought that the cysts are actually lined with endothelium rather than being simple clefts in connective tissues. Varying degrees of inflammatory changes are found in the vicinity of the blebs. Hemorrhage, edema, granulocyte infiltration and giant cells have been reported but they are not

constant features. Pertinent experimental studies by Wright[26] on the local reaction to the injection of gases into tissue have shown that giant cells appear at the end of about a week and that the air-containing spaces become lined with flat mesothelial-like cells after about six to eight days. These latter cells are thought to originate from the connective tissues. The giant cells and endothelial lining reported by others as so characteristic of the air cysts would appear from Wright's work to be a manifestation indicating chronicity.

From the material presented by Botsford and Krakower[4] it seems that there is a tendency for gas to accumulate in the submucosa in children as contrasted to its predominately subserosal location in adults.

CLINICAL DIAGNOSIS

There are no pathognomonic clinical findings. Usually the underlying disease, some form of intestinal obstruction, produces the predominant symptomatology. The pneumatosis is most often a surprising finding at operation or at postmortem. The preoperative diagnoses have varied, pyloric stenosis being the most common. In an analysis of eighty-five reported cases[14] with twenty-nine postmortem examinations the cause of death in 31 per cent was some complication of a gastric or duodenal ulcer. Of fifty-two operated patients 65 per cent had a gastric or duodenal ulcer. Approximately 50 per cent of the eighty-five cases were therefore associated with ulceration of the stomach or duodenum. Of this group 83 per cent were accompanied by some degree of stenosis.

It is conceivable that crepitation of the intestine might be elicited on abdominal palpation of such a patient, but no instance of this observation has been recorded. Diarrhea is often present and has been noted as a prominent symptom in children.

The diagnosis then rests on the roentgenologic demonstration of the cysts in association with the manifestations due to intestinal obstruction.

ROENTGENOLOGIC DIAGNOSIS

The appearance of the radiograph in pneumatosis intestinalis is characteristic. Once seen it should never be missed. It consists of localized accumulations of gas manifested as relatively circular translucent shadows outside the lumen of the bowel. The gas may also appear as radiolucent streaks, irregular patches or multilocular formations. The usual location of the gas is subserosal following the contour of the bowel wall or outlining the mesenteric or retroperitoneal planes. Occasionally enough gas may accumulate in the bowel wall to cause invagination of the mucosa,[9] resulting in narrowing of the lumen. When the gas dissects along the retroperitoneal planes, it may come to lie between the parietal peritoneum and muscular layer of the diaphragm simulating a pneumoperitoneum. In this situation, however, it cannot be displaced from its subdiaphragmatic location as may be done when it is free in the peritoneal cavity. Should the cysts rupture forming a pneumoperitoneum, gas may then be seen within, in and outside the bowel wall.

The conditions which must be considered in the roentgenologic differential diagnosis are those caused by gas-producing organisms or those due to traumatic or operative introduction of gas into the tissues. We have seen pneumatosis following retroperitoneal rupture of the duodenum, faulty placement of gas in perirenal insufflation and in artificial pneumoperitoneum.

TREATMENT

Turnure[20] suggested that the treatment of pneumatosis intestinalis was the correction of the fundamental or predisposing disease. He believed that the condition was self-limiting with a tendency toward spontaneous cure and if the factors contributing to the obstruction were treated there was no indication for resection of the affected bowel or any attempt at removal of the cysts.

That the pneumatosis will resolve has been borne out by case reports in the past.

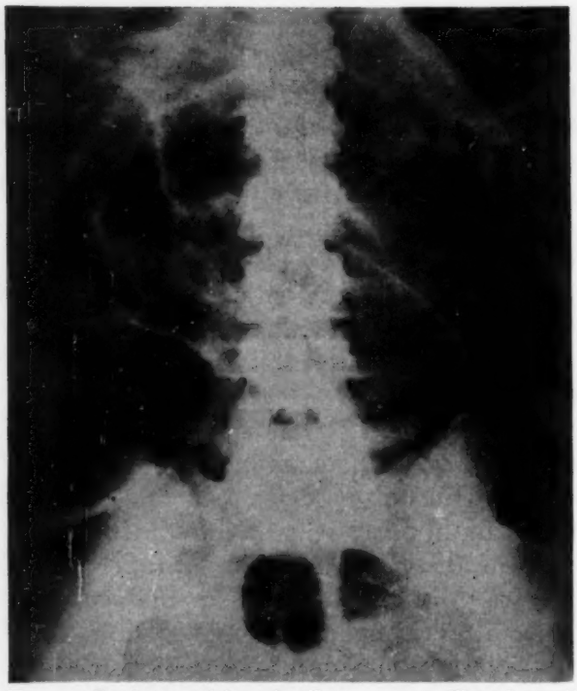

FIG. 1. Supine position April 30, 1947; dilated small bowel; upper abdomen overlaid by reticular pattern.

The case reported by Lerner and Gazin[9] showed a resolution of the pneumatosis intestinalis without operative interference. Mori in 1907 demonstrated that the gas cysts may undergo spontaneous resolution when nine months following an exploratory laparotomy he again entered the abdomen and found complete absorption of a former pneumatosis intestinalis. Berglund's patient[3] showed complete resolution of the pneumatosis at relaparotomy after three weeks.

When the process becomes irreversible, surgery may become necessary. The initial approach should be aimed at eliminating the obstructive factor. Simple lysis of adhesions has in some instances been sufficient to allow complete resolution of the pneumatosis. In others, secondary operations with bowel resection or short-circuiting procedures may be required. Surgical puncture of the cysts has been performed but they tend to reform.

CASE REPORT

The patient was a twenty-three year old, married, white female who was admitted on April 29, 1947, with complaints of almost constant abdominal distention, diarrhea and bouts of crampy abdominal pain.

In November, 1946 the patient consulted her local doctor in another city because of a rather profuse vaginal discharge. She was told she had a "precancerous lesion" of the cervix. On the 19th of November a cervical amputation, a partial suspension of the uterus, a bilateral tubal resection and an appendectomy were done. The postoperative course was stormy. Following the operation, the patient developed peritonitis with signs and symptoms of intestinal obstruction. One week after the first operation there was an evisceration through the lower midline wound. A week later she was again operated upon by her local doctor to relieve the intestinal obstruction. During the second operation "one portion of the small gut was perforated." Since this operation, the patient has complained almost constantly of abdominal distention and diarrhea. There have been two episodes of relatively acute crampy abdominal pain, the last occurring three weeks before admission to the Salt Lake County General Hospital. The family and present histories were non-contributory.

Physical examination revealed the following: blood pressure 112/72; temperature, 98.2° F.; pulse 84; respirations, 18. The patient was a very thin, young woman who appeared several years older than her stated age. She was in no acute distress. Essential findings were confined to the abdomen which was thin and protuberant. There was an incisional hernia in a lower midline scar extending from the umbilicus to the symphysis pubis. On observation one noted hyperperistalsis. The bowel was easily palpated but no crepitation was noted. There was rushes of borborgymi and high-pitched sounds. A moderate amount of fluid was demonstrable in either flank. There was no abdominal tenderness nor were any masses palpable.

Pelvic examination revealed a parous outlet. The vagina was clean. The cervix had been amputated flush with the vaginal wall. The site was well healed and a patent os could not be demonstrated. The corpus was fixed anteriorly, was somewhat tender but was not enlarged. No adnexal masses were felt.

Urinalysis, red blood count, bleeding time, coagulation time, blood urea nitrogen, plasma proteins, blood chlorides, Kahn, Mantoux and urine cultures were all normal.

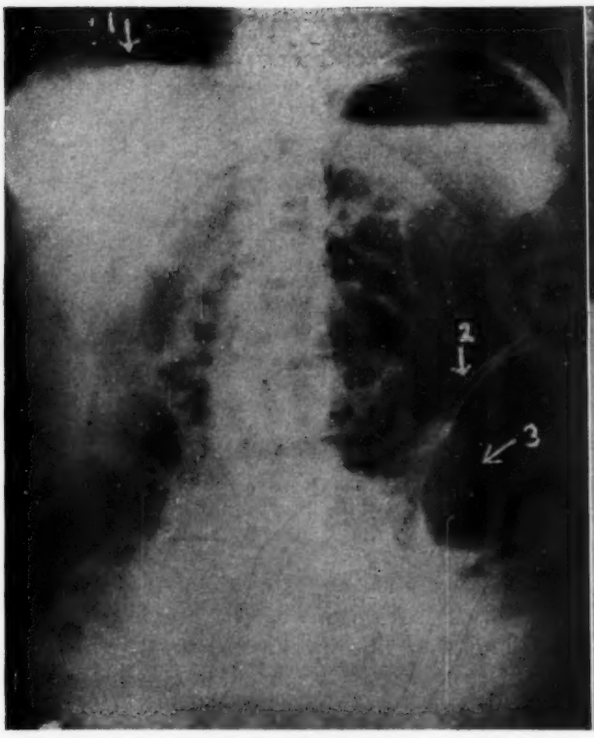

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FIG. 2. Erect position same day as Figure 1. (1), Gas under each leaf of diaphragm; (2), loops of small bowel separated by gas; (3), inverted "U" effect due to subserosal gas.
FIG. 3. Magnified view of left lower quadrant of Figure 2. (1), Gas between loops of small bowel; the inverted "U" is produced by gas in lumen of small bowel (2), wall of small bowel (3) and subserosal air (4). The reticular pattern is best reproduced on the figure. The cyst-like loculations of relative radiolucency are especially prominent to the left of the figure's center.

Scout films of the abdomen on April 30, 1947, revealed the following: In the supine position the upper half of the abdomen, especially the right upper quadrant, was overlain by irregular areas of relative radiolucency, forming a reticular pattern. (Fig. 1.) These areas varied in size and shape from pin point to approximately 1½ cm. in diameter, lying in close apposition to each other and appeared to be separated only by an irregular network of relatively denser strands. There were several loops of gas-filled distended small bowel. One segment was especially prominent and crossed the abdomen diagonally to taper to a point at the level of the inferior margin of the left sacro-iliac joint. There was a moderate amount of gas in the large bowel.

In the erect position there had been a marked shift in the position of the reticular pattern which now occupied the lower abdomen, especially the left lower quadrant. (Fig. 2.) The pelvis was overlain by a diffuse haze. There was a small amount of gas beneath each leaf of the diaphragm. Several loops of distended small bowel occupied the left lower quadrant. Two of these loops were separated by a narrow radiolucent area which allows delineation of the individual intestinal walls. There was also a loop of bowel, seen on end, which resembled an inverted "U" due to the differentiation between the gas in its lumen, the denser bowel wall and a strip of radiolucent gas following its outer contour. (Fig. 3.)

The gas beneath the right leaf of the diaphragm had shifted to overlie the liver in its lateral portion. The uppermost portion of the abdomen on this lateral film was occupied by distended loops of bowel which showed the peculiar net-like pattern. The dependent portion of the abdomen was obscured by a diffuse haze.

The contrast medium given on May 1, 1947, delineated a normal large bowel. The pneumatosis shifted considerably as contrasted to the relatively fixed large bowel and appeared to lie in the anterior portion of the abdomen.

The diagnosis was (1) intestinal obstruction, small bowel, partial; (2) hydropneumoperi-

FIG. 4. A loop of small intestine showing extensive involvement with subserosal gaseous cysts. Next to it is a segment of dilated but uninvolved small bowel.

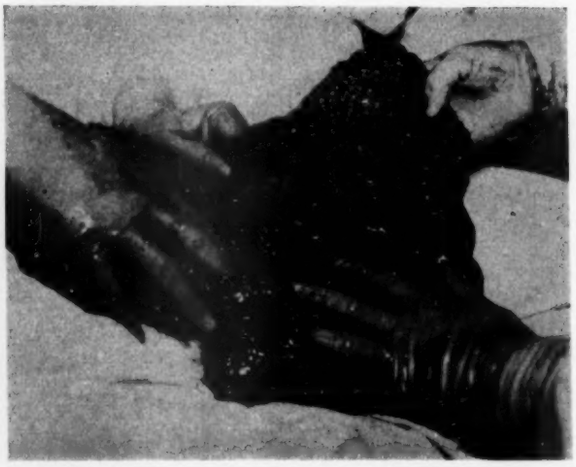

FIG. 5. This shows the foamy, nodular character presented on the surface of the small intestine. The translucent cysts are of different sizes; gas cannot be milked from one cyst to another.

toneum; (3) pneumatosis intestinalis, involving small bowel and its attached mesentery.

A significant feature about this patient was the fact that despite the uncommon roentgen findings she at no time seemed acutely ill. Indeed, at one time her condition was so good that she obtained permission from the staff to spend an afternoon visiting and shopping in the city.

On May 8, 1947, the old operative scar was excised and a midline hypogastric incision was made. Upon entering the peritoneal cavity no free gas was encountered; (in the week since the roentgenograms were taken it seemed that the free gas had been absorbed.) There was a moderate amount of slightly brownish, somewhat turbid, thin, odorless fluid present. The intestines presented a remarkable appearance. Most of the small bowel was involved by adhesions some of which were long and stringy. After lysis of numerous adhesions it was found that the first 45 inches of the jejenum distal to the ligament of Treitz appeared normal. The next 15 inches showed distention but no other gross abnormality.

The following 48 inches were involved by pneumatosis. Here the intestinal lumen was distended and the walls thickened. The serosal surface was raised in a foamy nodular fashion by a great mass of translucent, thin-walled cysts of various sizes. (Figs. 4 and 5.) Most of these cysts contained gas which was odorless. A few of them contained a small amount of fluid. In some places the blebs extended down into the mesentery which presented a "shredded" appearance due to numerous ragged rents. This sector of bowel showed marked distention down to a point where the intestine was sharply kinked and firmly adherent to the pelvic organs. The remaining distal portion of the small bowel was normal in appearance. The large intestine was not involved nor could any similar cysts be found in the walls of the other viscera or in the parietal peritoneum.

The obstructive attachment of the bowel to the pelvic organs was freed and the small intestine carefully examined for intraluminal obstruction. It was then possible to milk air in the small intestine from the ligament of Treitz to the ileocecal valve. The gas in the individual cysts could not be forced into adjacent cysts.

Because the external cervical os had been destroyed, a supravaginal hysterectomy was done with removal of the right ovary. The floor of the pelvis was reperitonealized and the abdomen closed with repair of the incisional hernia. The patient was in a good condition after the operation.

Postoperatively, the patient did well. Wangensteen suction was used for thirty-six hours. She had no distress after removal of the suction tube. Tension sutures were removed on the eighth day following operation. The wound at that time was well healed. Postoperative x-rays revealed the disappearance of a large percentage of the pneumatosis intestinalis. A small amount was still present in the lower left quadrant on the ninth postoperative day, with moderate distention of the small bowel.

The patient was discharged on the eleventh postoperative day. She was seen in the fifth

postoperative week and had gained 7 pounds in weight. She still had occasional short-lived episodes of abdominal pain and distention but no diarrhea. Consequently, five weeks following the first operation she was hospitalized for a forty-eight-hour observation period and conservative therapy. Despite utilization of 100 per cent oxygen inhalations, belladonna and a Cantor tube to relieve the distention, she continued to have recurrent bouts of meteorism and remained quite uncomfortable.

Ten days later a roentgenogram revealed a recurrence of the pneumatosis. The results of the period of conservative therapy were then judged to be inadequate and laparotomy was decided upon as the next procedure.

At the second operation on July 18, 1947, the intestines presented a gross appearance similar to that seen at the first operation, but this time the pneumatosis was more extensive, involving the whole mid-portion of the small intestine for a distance of 12 feet. The mesentery was slightly involved. The stomach, colon and retroperitoneal tissues were free of changes. There was approximately 200 cc. of blood-tinged fluid in the abdominal cavity. An interesting observation was that the pneumatosis involved the segments of bowel in such a fashion as to suggest that direct extension had occurred across adhesions between serosal surfaces of adjacent loops of bowel. An otherwise normal loop of bowel would seem to be involved where it became stuck to a tangle of emphysematous intestine. The gas in the blebs again had no odor. A large cyst filled with approximately 100 cc. of fluid was adherent to the anterior abdominal wall. The adhesions were more numerous than at the time of the first operation and were generally broader and firmer. Cultures were taken of a large and a small cyst as well as of the free abdominal fluid.

Fourteen feet of small intestine (extended length) were resected. This included all of the grossly involved small bowel and left the patient with 4 feet of normal-appearing jejunum and 9 inches of terminal ileum. An open, end-to-end anastomosis was performed without difficulty.

Postoperatively the patient did well. There was no distention and roentgenograms showed no evidence of pneumatosis one week following surgery. Five months after discharge the patient was free of distention and pain and had gained 20 pounds. Fatty foods in moderate quantity were well tolerated and she had only one bowel movement a day. An erect scout film of the abdomen and a study by barium enema failed to reveal evidence of intestinal emphysema at this time.

FIG. 6. Opened segments of resected bowel. The distal end is smaller than the proximal end which is almost twice its diameter. The segments are grossly involved with pneumatosis intestinalis externally but the mucosal surface is entirely devoid of cysts.

No growth in the cyst and abdominal fluid was reported under aerobic or anaerobic conditions, using blood agar, Sabourauds, thioglycollate and broth media. Direct smears were negative for bacteria, molds, fungi or parasites. Intraperitoneal inoculation of the patient's cystic and intra-abdominal fluid into white mice did not kill the animals in four weeks.

Grossly, almost the entire specimen of resected bowel was involved by the process. (Fig. 6.) This consisted of numerous small, gas-containing blebs or cysts over the entire serosal surface, varying in size from pin point to that of a large olive pit. (Figs. 4 and 5.) The accumulations of gas appeared to be larger toward the distal than the proximal end of the bowel. These cysts were elevated, separating the serosal covering from the subserosal layers. The lumen of the bowel was larger than normal. This was particularly true of its proximal portion. There were many ragged, fibrous adhesions present along the serosal surface. Both internal and external inspection of the entire intestine failed to reveal any demonstrable break in the mucous membrane. (Fig. 6.) The small cysts resembled to a great degree those found in a hydatid mole except that here only a few contained cloudy fluid. The gas within

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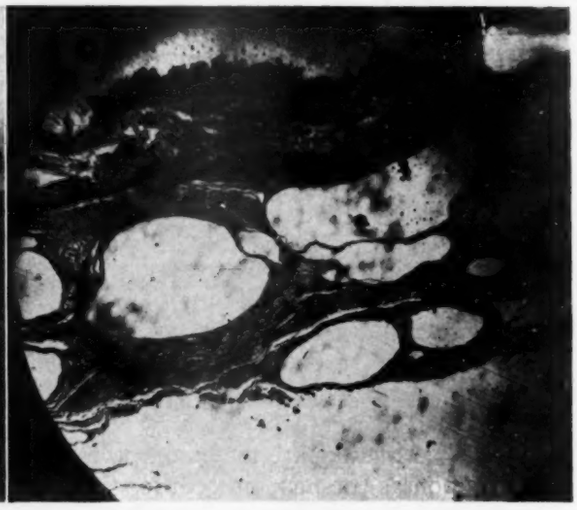

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FIG. 7. The mucosa is infiltrated with plasma cells, lymphocytes and eosinophils. No gas is seen in the submucosa. This contrasts sharply with Figure 8 in which gas cysts are seen in the subserosal area.
FIG. 8. A low power view of the full thickness of intestinal wall. The discrete gas cysts lie entirely external to the muscular coats of the bowel wall.

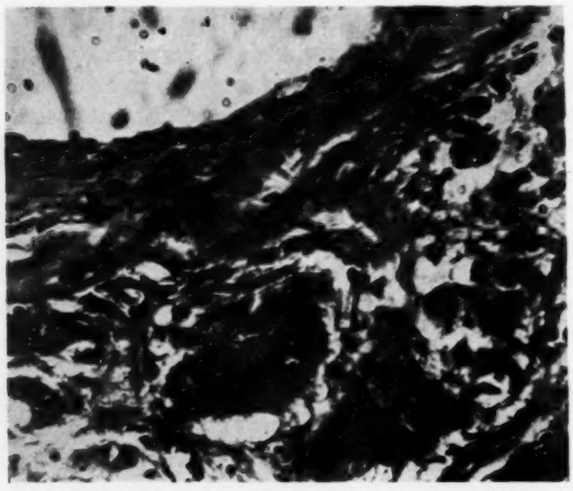

FIG. 9. Giant cells surrounded by eosinophils and lymphocytes; the clear space is a subserosal gas cyst.

the cysts could not be milked out or forced along the subperitoneal planes. Upon rupturing the cysts the gas acted as if it were under pressure.

Microscopically, the mucosa was infiltrated with plasma cells, lymphocytes and eosinophils. (Fig. 7.) The muscularis itself was not involved in the cystic process. In some areas it showed a moderate amount of fibrosis and infiltration with few lymphocytes. Opposite the large subserosal cysts the muscular layers were thinned, probably due to pressure from the accumulations of gas. Within the subserosal layer of the wall there were many clear cystic areas varying in size from 1 to 10 mm. in diameter. (Fig. 8.) Upon examination it appeared that some of these cysts were lined by "endothelium." In many instances the cyst wall was devoid of any cell lining. At some points in the walls there were numerous macrophages and eosinophils. In a few places focal hemorrhages were seen. An interesting finding was a layer of collagenous and granulomatous tissue containing many lymphocytes, plasma cells and eosinophils surrounding some of the cysts. Giant cells containing two to twenty nuclei and giant cell granulomas were also seen in scattered areas. (Fig. 9.) The distribution of the cysts did not follow a definite pattern. They appeared to be discrete and variable in shape and size.

COMMENTS

Although pneumatosis intestinalis has been reported more frequently in recent literature it is still of sufficient rarity to warrant another case report. The terminology used in European literature has been carried over into the American. It may be that subsequent reports in the literature will prefer the term intestinal emphysema to pneumatosis intestinalis.

The incidence of diagnosis is undoubtedly based upon the awareness of the physician to the presence of such an entity. Once seen it is not likely to be forgotten. It should be remembered in the differen-

tial diagnosis of any case of intestinal obstruction.

The numerous theories as to the entry of gas into the bowel wall can probably be disregarded with the exception of the mechanical factor superimposed on an ulcerative lesion. Once the gas has attained access to the subserosal muscular place it appears to produce mechanical obstruction of the lymphatics and inflammatory changes, resulting in progressive intestinal emphysema. The cysts apparently represent accumulations of gas which cannot be disseminated or absorbed.

The clinical diagnosis may be suspected by an individual familiar with the entity. The actual diagnosis rests upon radiologic demonstration and surgical proof. The characteristic x-ray finding of radiolucent streaks or discrete loculations scattered along the bowel wall should therefore be made familiar to everyone. The possibility that these accumulations may rupture and permit escape of the gas into the peritoneal cavity forming a pneumoperitoneum should also be remembered.

The treatment depends upon the individual case. Since many of the cases resolve without surgery, it is probably wisest at first to follow a conservative medical or surgical program. If the condition becomes progressive or is recurrent, then radical resection or a short-circuiting procedure may be necessary.

The case reported herein is classical in that the patient had the typical clinical picture of intestinal obstruction, diarrhea and extensive pneumatosis intestinalis upon x-ray. In place of the common finding of associated pyloric stenosis this patient's stenotic factor was multiple intestinal adhesions.

SUMMARY

The first American report of a roentgenologic preoperative diagnosis of pneumatosis intestinalis is presented. The characteristic roentgenographic features are described.

The various etiologies of this entity are discussed and a theoretical concept of its development is presented. It is suggested that the process is as follows: A break develops in the mucous membrane of the bowel associated with some form of partial or complete obstruction of a part of the intestinal tract distal to this mucosal defect. The obstruction may occur from stenosis or adhesions. Because of the obstruction, hyperperistalsis take place and forces gas out of the lumen of the bowel into the wall where it comes to lie either in the subserosal or the mucosal layers. The presence of the gas causes obstruction of the lymphatics and associated inflammatory changes. Normally the gas is re-absorbed. If, however, the inflammatory and stenotic factions persist in the lymphatic system and become marked, absorption of the gas is blocked and the process become irreversible.

The problem of conservative versus radical surgery in the treatment is raised. It is the opinion of the authors that the management of this entity demands a careful evaluation of the stage to which any given case has progressed. If the features of the case appear to be irreversible, radical surgery is indicated. In many cases simple relief of the obstruction may be sufficient. The case presented in this report is one in which conservative surgical management (lysis of adhesions) was tried at first, only to require the more radical procedure of extensive small bowel resection at a later date.

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MALIGNANT TUMORS OF THE SMALL INTESTINE*

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MALIGNANT tumors of the small intestine demand not only early roentgenographic study for their recognition but also closer clinical observation of the characteristics and development of the morbid process. The onset of the disease is so insidious that marked asthenia and severe anemia may be present before the disease encroaches on the lumen as the correct diagnosis is rarely made before the onset of partial obstruction. Fractional radiographic examination before obstructive symptoms are manifest have not infrequently failed to disclose proximal distention or interference with mobility. The rapid extension of the disease into the rich, inaccessible lymphatics often preclude a successful outcome even though technically the disease and adjacent mesentery appear to have been extirpated. Four cases are reported because they manifest different phases of the morbid process.

CASE REPORTS

CASE 1. No. 55812, B. G., a forty-five year old male, was admitted to Beth Moses Hospital on October 25, 1932, complaining of pain and vomiting. In 1920 a cholecystectomy and appendectomy had been performed. For about two months before admission he was treated in the out-patient department of another hospital for pain in the epigastrium. There he had a gastrointestinal series. He was told that he had an ulcer and was placed on a Sippy diet. The pain came on before and after meals but was not severe enough to keep him from working. He noticed that he was getting weaker. For two days before admission the pain was in both lower quadrants. The pain was sharp, stabbing in character, did not radiate but was intermittent and aggravated by deep breathing. This persisted until admission when the pain became localized in the epigastrium and the stools became black. The patient had lost 18 pounds in five months.

At examination, the patient looked drawn, chronically ill and emaciated. He weighed 157 pounds. The abdomen was distended and there was resistence and tenderness in the right upper quadrant. There also was tenderness in peri-umbilical regions. Some irregularity was noted in the epigastrium. There was marked right costovertebral tenderness. Laboratory data were: red blood cells 4,350,000, 65 per cent hemoglobin, white cell count 12,920, polymorphonuclears 87 per cent; Wassermann negative, stools positive for blood; sugar 125 mg. per cent, urea nitrogen 15 mg. per cent, chlorides 385 mg. per cent, icteric index 6.9, cholesterol 225, ester 72, per cent 32. Fractional gastric analysis revealed free acid ranging from 14 to 29, total acidity from 42 to 59, bile was 4+ and only the initial specimen showed a trace of blood; urine was negative.

For the next ten days the temperature fluctuated from 99 to 101°F. There was persistent tenderness in the right upper quadrant and epigastrium. The white cell count on alternate days varied from 5,400 to 14,000. Repeated radiographic examinations of the diaphragm suggested right diaphragmatic adhesions. The chest did not show any adventitious shadows. No barium studies were made because a diagnosis of a sealing-off perforating ulcer was entertained. Intermittent gastric suction and supportive parenteral feedings were instituted. Spasm and tenderness persisted over a mass which was palpable in the upper right half of the abdomen. The general condition of the patient did not seem to improve. Operation was advised for a presumptive diagnosis of a walling off perforating carcinomatous ulcer of the stomach.

On November 4, 1932, under spinal anesthetic and a blood transfusion the abdomen was opened through an upper right, rectus incision. A cystic, firm pearly gray-yellow mass 15 cm. in diameter was found ulcerating

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FIG. 1. Case 1. Myosarcoma of duodenum with portion of stomach.

into the first and second portions of the duodenum and attached to the posterior wall of the stomach. The mass contained about 1 pint of dark brown clear fluid. The tumor could be readily separated from the stomach, from the undersurface of the liver and from the thin posterior adhesions. Nodular masses were noted in the retroperitoneal tissue and in the leaves of the omentum. There was no extension into the pancreas. The right kidney was small and grossly normal. The first and second portions of the duodenum and the distal third of the stomach were resected. The severed ends of the duodenum and stomach could be approximated without tension, a Billroth No. 1 type of resection. A Levine tube was inserted beyond the stoma. (Fig. 1.)

Microscopically, all sections presented a similar appearance with a cytoplasmic and fibrillar reticulum. The cytoplasm was clear. The nuclei showed considerable variations in size, shape and tinctorial capacity. Multinucleated and giant forming cells were noted; mitoses were frequent; the nodules were composed of similar tissue.

Diagnosis: Myosarcoma with lymph node involvement. (Fig. 2.)

Postoperatively the patient developed a leakage at the stoma on the sixth day. Suction drainage was established from the depths of the wound. The patient was kept on parenteral

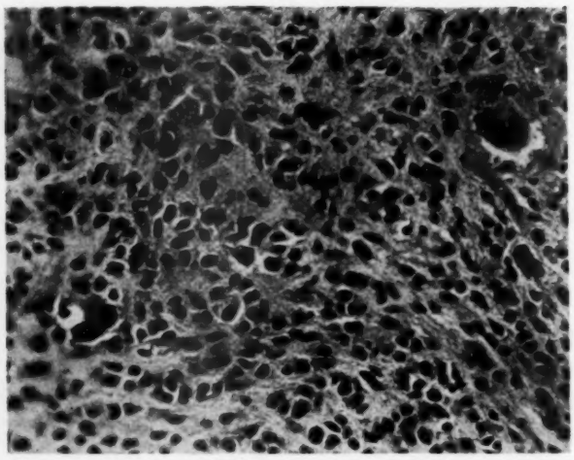

FIG. 2. Case 1. Cellular atypism with structural changes of myosarcoma.

fluids but he died on the fourteenth day. Autopsy revealed a leakage of the gastroduodenal anastomosis and bronchopneumonia.

Comment. This patient presented an extrinsic degenerated and bulky sarcoma of the duodenum causing compression of the lumen and illustrated the difficulty of early radiographically establishing the presence of an extrinsic tumor. While technically the resection and a Billroth No. 1 was readily effected without tension, it is apparent that the procedure of choice should have been a short circuiting operation to decompress partially the edematous tissue followed by resection at a subsequent date.

CASE II. No. 2411, Mrs. G. F., a white woman, age fifty-eight, was admitted to the Brooklyn Cancer Institute on January 14, 1946, complaining of intermittent vomiting of three months' duration. Cholecystectomy and appendectomy were performed in 1931. For one year she had had gaseous distress. Three months before admission she began to complain of nausea and vomiting after heavy meals. She was put on a light diet and amphojel with some relief; vomiting persisted. There was no history of abdominal pain; her appetite was good but she hesitated taking food for fear that she would vomit. There was no blood in the vomitus. The patient was not constipated and there was no evidence of blood in the stools. The radiographic examination two weeks prior to admission suggested the presence of partial obstructive neoplasm

in the proximal jejunum, approximately 4 inches from the ligament of Treitz.

Physical examination revealed a well developed female with heart and lungs essentially normal. There was a firmly healed, right rectus scar. A mass was palpable about 2 inches to the left of the midline midway between the costal margin and umbilicus. This was 2 inches to 3 inches in diameter, firm and partially fixed posteriorly although it had a range of mobility of 45 to 60 degrees. There was no apparent enlargement of the liver nor were there any supraclavicular nodes palpable.

Radiographic examination on January 18, 1946, revealed that the duodenum and the most proximal portion of the jejunum was dilated to three times its normal width and apparently came to a sudden stop just beyond the duodenojejunal junction. After several minutes the barium penetrated through a very fine channel approximately 2 inches long beyond which the jejunum again became visible. Two hours later the constricted area in the jejunum was clearly visible for approximately two inches. After six hours there was almost 50 per cent of the barium in the antrum and duodenum. (Fig. 3.)

FIG. 3. Case 11. Roentgenogram showing dilated duodenum and most proximal portion of jejunum.

Laboratory data are as follows: Gastric analysis on January 18th showed a faint trace of blood in the fasting specimen but none in three subsequent examinations. The free and total acidity was normal. The hemoglobin was 68 per cent, red blood cell count was 3,730,000, white cells 13,800, 64 per cent polymorphonuclear leukocytes, hematocrit 39 per cent, urea nitrogen 23.0 mg. per cent, sugar 129 mg. per cent, chlorides 460 mg. per cent, the total proteins 7.5 Gm. per cent, albumin 4.89 per cent and globulin 2.55 per cent. A provisional diagnosis was made of malignancy of the jejunum with partial obstruction. On January 21st a Levine tube was inserted and intermittent Wangensteen suction was established. During the next three days the patient received 4,000 cc. of amigen and 1,500 cc. of blood.

On January 23, 1946, under continuous spinal anesthesia and a transfusion the abdomen was opened through a midline incision. Two inches beyond the ligament of Treitz and intimately adherent to the transverse colon there was a mass approximately 8 by 5 by 5 cm., bluish purple in color, studded with white placques 1/16 inch to 1/4 inch in diameter, with marked foreshortening of the mesentery with several small mesenteric lymph nodes. (The lumen presented a cauliflower fungating appearance involving the entire circumference and causing almost napkin-ring constriction.) The disease process extended into all layers and there was one area 3/4 inch which was white and sclerotic. There was some dilatation of the proximal jejunum. There was no gross evidence of metastasis to the liver. The tumor was resected with the foreshortened mesentery beginning 1 inch from the ligament of Treitz to 3 inches beyond the lesion. The distal divided jejunum was closed with three layers of No. 1 silk sutures and an end-to-side anastomosis was established between the proximal jejunum and the distal jejunum. (Fig. 4.)

Microscopically, at the junction between normal mucosa and the neoplastic area a transitional zone was present. Individual cells lacked mucous globules, were elongated and contained long hyperchromatic nuclei. The papillary mass presented a similar picture although loss of normal polarity was more evident and there was invasion of the underlying tissue. The wall was widely invaded by nests of tumor cells which involved all the layers. Their appearance varied, the predominating feature being large areas of mucoid material within which were widely scattered small nests, rows and glands of columnar cells.

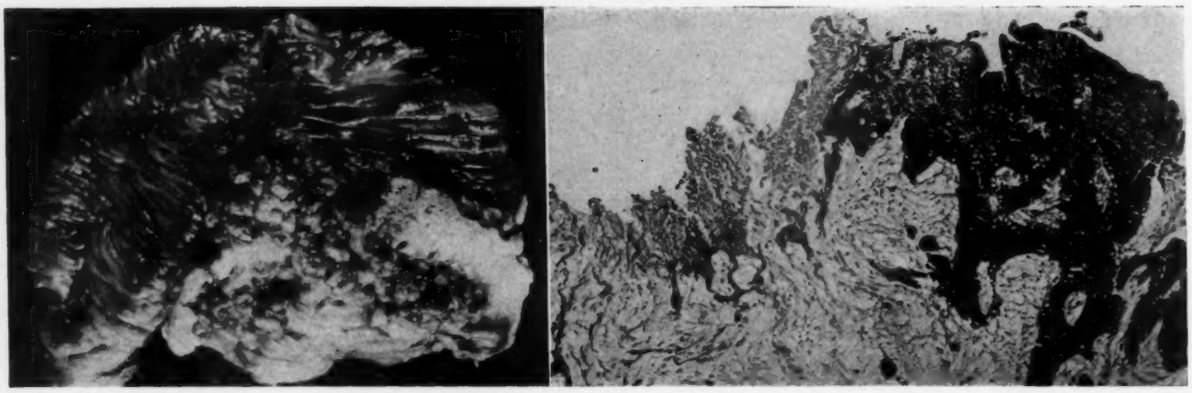

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FIG. 4. Case II. Cut section of the ulcerating carcinoma of jejunum.
FIG. 5. Case II. Microscopic appearance of the gelatinous papillary carcinoma of the jejunum.

Many were distinctly mucous-secreting and signet ring forms were frequent. Other masses were in small solid sheets or cords; these cells were more uniform and embryonal in appearance. The lymph node was completely replaced by tumor tissue.

Diagnosis: gelatinous papillary carcinoma of jejunum. (Fig. 5.)

Postoperatively intermittent gastric suction was maintained for five days; amigen, blood, penicillin and intravenous sulfadiazine were given until the fifth day. The patient was discharged on February 6th with complete relief of symptoms. One month later symptoms recurred and she died April 8, 1946, two and a half months after the operation.

Comment. This patient had a carcinoma of the jejunum near the ligament of Treitz with an insidious onset of one year, acute symptoms of partial obstruction for three months, palpable tumor and radiographic diagnosis of an advanced lesion. The extensive tumefaction, lymph node involvement and extension of the disease into the foreshortened mesentery made impossible the complete radical extirpation of the rich bed of inaccessible lymphatics which was essential for a successful outcome.

CASE III. No. 121603, E. S., age forty-five, a white female was admitted to Beth Moses Hospital January 8, 1946, complaining of intermittent abdominal pain and vomiting of two weeks' duration. In September, 1944, she consulted a physician in Cleveland because of a loss of 10 pounds, progressive weakness, poor appetite, belching and heartburn. Her normal weight was 130 pounds. She never noticed blood in her stools nor did she complain of diarrhea or constipation. Her hemoglobin was 66 per cent. A gastrointestinal series suggested a gastric ulcer. She continued to get progressively weaker and returned to New York in December, 1945, with a hemoglobin of 32 per cent and weighing 100 pounds. On admission to the hospital she complained of intermittent vomiting of two weeks' duration, epigastric pain, gaseous distress, marked weakness, extreme pallor, constipation and occult blood in her stools.

The patient was acutely distressed and extremely pale. There were palpable cervical and axillary lymph glands. The heart and lungs were essentially negative. The abdomen was soft; there were no masses palpable. The hemoglobin was 8.5 Gm., red blood count 3,690,000, white blood count 10,750, 77 per cent polymorphonuclears. There was central achromia of the red cells. The urine was negative. The stool was positive for blood but no ova or parasites. Fractional gastric analysis revealed a free acid from 0 to 6 and total acidity 20 to 20 millimoles per cent, 3+ bile and blood 2+. The prothrombin was 31 seconds, prothrombin index 1.55. At this time the sugar was 125 mg. per cent, urea nitrogen 16 mg. per cent, chlorides 460 mg. per cent, cholesterol 210, ester 175, cephalin cholesterol flocculation negative; total proteins 5.25 Gm. per cent, albumin 2.59 per cent, globulin 2.61 per cent. Radiographic examination on January 17, 1946, at the end of six hours there was marked dilatation of the small intestine; the head of the advancing column of barium was in a distended sausage-

like ileum. At twenty-four hours the shadow contents assumed two parallel rows of distended jejunum with the left low ileal dip. There was noted a slow thin seepage of the shadow meal through ill defined lowest ileum. (Fig. 6.) At thirty hours there was very little change in arrangement of the loops of small intestine; some filling of the caput cecum was noted. At 120 hours the tip of the Miller-Abbott tube was in the lowest portion of the ileum above the point of obstruction which is about 1 foot from the cecum.

A Miller-Abbott tube with intermittent suction slightly relieved the distention. Repeated transfusions, amigen, liver extract, vitamins B, C and K were given. The patient did not improve. Rigidity, distention and marked tenderness increased; the hemoglobin remained at a 32 per cent level.

Exploratory celiotomy was performed on January 22, 1946, under continuous spinal anesthesia and a transfusion through an inner right rectus incision. There was straw-colored fluid in the abdomen. About 18 inches from the ileocecal valve there was a purplish red semi-firm mass and distended small intestine approximately 8 inches long and 2 to 3 inches wide. This consisted of an obstructing tumor of the ileum and an intussusception. There were numerous large purplish mesenteric glands. The intestine and mesentery and glands were resected well beyond the tumefaction. The continuity was restored by an end-to-end anastomosis. (Figs. 7 and 8.)

The resected specimen measured 92 cm. of ileum; the proximal 28 cm. were markedly dilated and the distal 6 cm. were collapsed. The intervening 58 cm. consisted of a doughy elliptical mass measuring 19 cm. This was due to an intussusception. The proximal bowel was twisted through an angle of 180 degrees. When opened, 3 small masses, 2 to 3.5 cm. in diameter, were noted at its proximal line of intussusception and at its apex. These masses were firm in consistence and presented grayish-green discoloration on cross section. They were situated within the submucosal and muscular layers. The intussuscepted bowel presented a hemorrhagic appearance with considerable plastic exudate on its serosal surface.

Microscopically, the three masses presented a similar appearance consisting of polyhedral cells with clear, vacuolated or finely granular cytoplasm. The nuclei showed considerable

FIG. 6. Case III. At twenty-four hours the shadow contents assume two parallel rows of distended jejunum with the left low ileal dip. There is a thin seepage of the shadow meal through the ill defined lowest ileum.

atypism. Mitoses were numerous. Differential nerve and muscle stains were inconclusive.

Diagnosis: Sarcomas of the ileum; intusssusception of ileum with hemorrhagic infarction and localized peritonitis. (Fig. 9.)

The immediate postoperative convalescence was uneventful. Flatus was expelled on the third day and a spontaneous evacuation occurred on the sixth day. After repeated transfusions she was discharged on February 10, 1946, with a hemoglobin of 11 Gm. and red blood cell count 4,120,000.

Five days after discharge from the hospital she was readmitted complaining of severe frontal headaches, nausea and vomiting of two days. The hemoglobin was 7.5 Gm., the red cell count 3,550,000. A Miller-Abbott tube was passed and intermittent suction reestablished. On February 23rd she had bilateral blurred optic nerves, a left central facial and more active tendon reflexes on the left Babinski. This was interpreted as an increased right intracranial pressure due to metastasis. In March nodules appeared under the skin almost over her entire body including her face. Biopsy of one of the skin nodules revealed metastatic sarcoma. In spite of repeated transfusions and supportive treatment the hemato-

FIG. 7. Case III. Resected obstructed sarcoma of the ileum and intussusception.

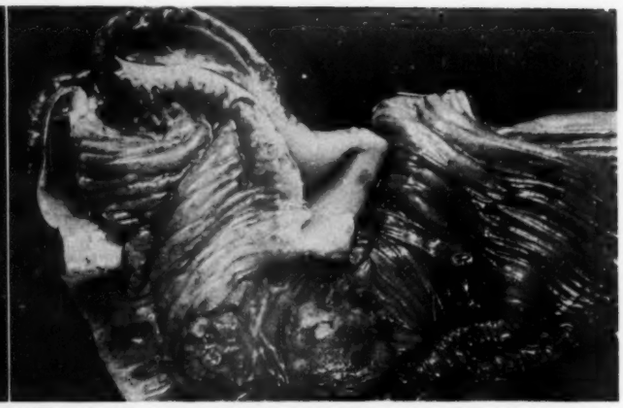


FIG. 8. Case III. Sectioned intussusception revealing multiple tumors.

FIG. 9. Case III. Microscopic appearance of sarcoma of the jejunum.

crit on March 8th was 14 per cent and the chlorides 540 mg. per cent, total proteins 4.35 Gm. per cent. On April 8th the hemoglobin was 7.5 and the red cell count 2,460,000. Since her readmission she was disoriented except for short intervals and she became progressively weaker. She died in a coma on May 5, 1946.

Comment. This patient serves to illustrate treatment failure due to delay in diagnosis with resultant chronicity, severe anemia, extreme pallor, asthenia and marked loss of weight. The manifold lesions included sarcoma of the small intestine, polyps, intussusception, perforation sealed off by an inflammatory exudate, cerebral and multiple skin metastasis.

CASE IV. No. 28936, D. B., a sixty-one year old white male, was admitted to the Brooklyn Cancer Institute on June 15, 1939, complaining of abdominal pain, weakness and loss of weight. For one year he had severe epigastric pain, usually occurring one and one-half hours after meals. The pain radiated around the abdomen to his back. He could get some relief with a lacto-fine vegetable diet or by belching. Six and two months before admission a gastrointestinal series were reported negative. He continued to complain of epigastric pain, progressive weakness and shortness of breath and for the last six months of a loss of 40 pounds. He stated that his stools were normal in color and consistency. In May, 1939, another gastrointestinal series in the clinic was reported negative. The stools were positive for occult blood. Physical examination disclosed a well developed chronically ill male showing evidence of recent weight loss. He weighed 158 pounds. Blood pressure was 132/90. The heart and lungs were essentially negative.

The abdomen was scaphoid and wrinkled. There was a freely movable irregular mass the size of an orange in the lower right quadrant. There was a persistent gurgling and tenderness over the mass. Sigmoidoscopic examination suggested an extrinsic mass approximately 9 cm. from the anus. The hemoglobin was 53 per cent, erythrocytes 3 million, the white cell count 7,850, the differential was normal;

the urea nitrogen 17 mg. per cent, sugar 118 mg. per cent. The urine was negative; occult blood was present in the stools. The Wassermann-Kline test was negative.

Gastrointestinal roentgenograms, the fourth in six months, fractional studies one, two, three and four hours revealed the ileum filled with barium. Seven hours after the meal most of the meal was in the colon. It was noted that the small intestine was found at all times above the pelvic cavity as though it was pushed upward. The barium enema suggested a mass in the pelvic cavity pressing on the bladder and sigmoid. The small intestinal studies suggested a large mass pressing on the ileum about 15 cm. from the cecal valve. (Fig. 10.) Intravenous pyelogram of the kidneys was negative but showed a shallow impression in the upper portion of the bladder suggesting a mass above the bladder.

Because of the persistence of pain, loss of weight, the presence of blood in the stools, a palpable movable mass, with negative intrinsic radiographic reports, a presumptive diagnosis was made of an extrinsic carcinoma which may have ulcerated into the bowel. Surgical intervention was advised.

Exploratory celiotomy was performed on June 26, 1939, under spinal anesthesia. There was a firm, rubbery and nodular mass in the pelvis approximately 10 cm. in diameter involving the ileum and its mesentery close to the posterior abdominal wall. About 4 inches of the ante-mesenteric portion of the sigmoid was attached to the ileum and its mesentery. There were two small white placques about 1 cm. in diameter on the serosal surface of an adherent portion of ileum. The involved ileum and sigmoid were resected, including 8 inches of the former and 4 inches of the latter. The two white placques on the ileum were excised. The continuity of the ileum was restored by a side-to-side anastomosis approximately 12 cm. from the ileocecal valve. The clamped distal and proximal loops of the sigmoid were approximated with fine silk. (Figs. 11 and 12.)

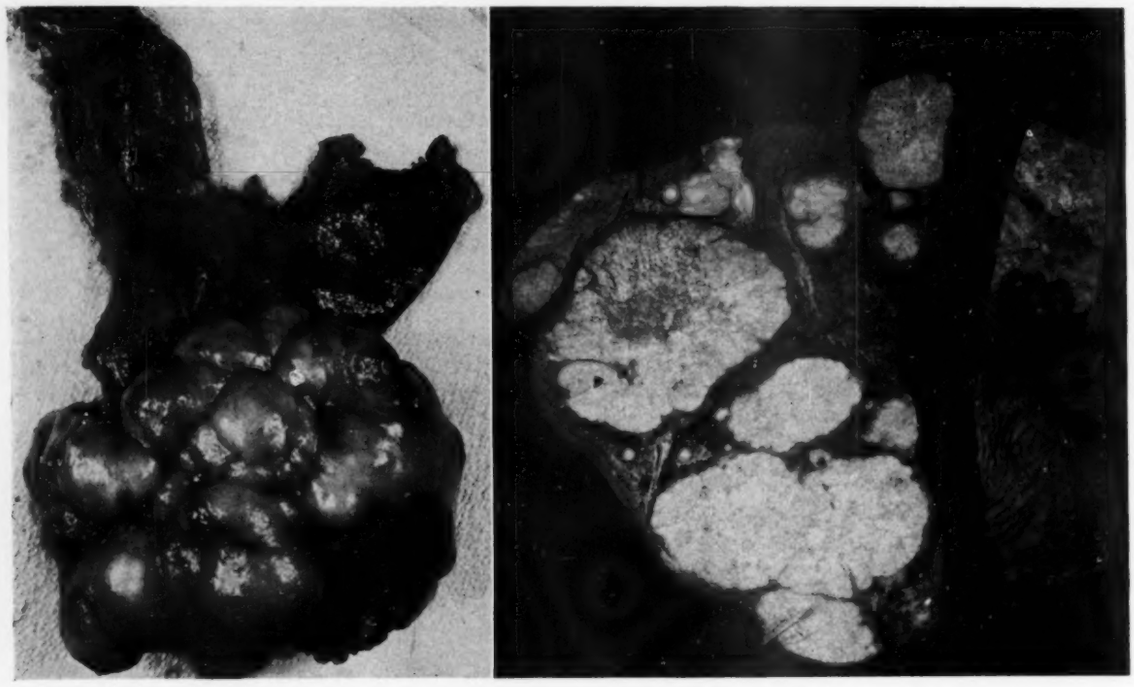
The specimen consisted of 22 cm. of ileum; the central portion was acutely kinked. Attached to the wall at this point and involving all its layers was a soft, yellowish multilobular mass 13 by 9 by 8 cm. ulcerating the mucosa for 4 cm. at the point of angulation. The opposite end of the mass was adherent to a section of large intestine reaching its muscularis. The large bowel mucosa presented a polyp 0.3 cm. in diameter. Two peritoneal nodules 0.8 cm. in diameter were firm and homogenous white on cut section. The microscopic examination disclosed a mass composed of sheets of tumor cells in wide bundle arrangement. The cells were spindle in type, with vesicular or hyperchromatic nuclei. Regular mitotic figures and giant forms were common. The ulcer bed was covered by a fibrino purulent layer. The tumor invaded the serosa of the sigmoid. The peritoneal nodules consisted of similar tumor tissue. The colonic polyp was benign epithelial.

FIG. 10. Case IV. Roentgenogram showing partial obstruction and upward displacement and fixation of intestine.

Diagnosis: Leiomyosarcoma of small intestine with extension to the colon and peritoneum. (Fig. 13.)

The post operative convalescence was complicated by urinary difficulty for fourteen days. The proximal clamp was removed on the fourth day, a crushing clamp was applied to the sigmoid spur on the fourteenth day and removed nine days later. The colostomy was closed extraperitoneally thirty-five days after the resection. He was discharged from the hospital sixty-one days after the resection having gained considerable weight.

The patient returned to the follow-up clinic. When seen on November 14, 1939, he had gained 20 pounds and weighed 182 pounds.



11 12

FIGS. 11 and 12. Case IV. Gross and cut section of leiomyosarcoma of ileum and sigmoid.

There was, however, evidence of a mass in his abdomen. He was given x-ray therapy. Radiographic examination one hour after a barium meal failed to reveal any obstruction in the course of the small intestine; the head of the barium had reached the cecum; the area of the resection and anastomosis was demontrated by diminished filling and other loops of small intestine above and below this area were encroached by adjacent masses.

The patient received several courses of deep x-ray therapy but gradually became weaker and continued to lose weight and his abdomen became markedly distended. Several masses were felt in his abdomen; they gradually became larger and caused him considerable distress. He expired August 21, 1940, fourteen months after the operation and probably two years after the onset of his symptoms.

Comment. This patient had a protracted history of vague intestinal symptoms and illustrated the difficulty in detecting early signs of disease or interpreting early roentgenograms. Three gastrointestinal series within six months were reported negative. A large tumor of the ileum was present invading the colon and lymphatics and implanting itself on adjacent ileum. This patient had severe anemia, asthenia, prostration and partial obstruction for a long time before acute obstruction late in the disease prompted intervention. Early recurrence was inevitable because of the difficulty of completely extirpating the disease and all of the lymphatics. The disease was resistant to deep therapy.

Incidence. The tumor is comparatively rare, the literature containing only individual or small group case reports.[1–9] Ewing[10] states that malignant tumors of the small intestine comprise about 3 per cent of all malignancies of the gastrointestinal tract. Ficarra and Marshall[11] reported that on the basis of surgical specimens and autopsy material, small intestinal carcinoma has a reported incidence varying from 0.46 per cent to 6 per cent of all gastrointestinal cancers. They noted that twenty-nine cases had been seen in the Lahey clinic in thirty years. Horsley[12] reviewing the literature from Raiford's[3] contribution in 1932 to January 1, 1941, found 384 cases of carcinoma and carcinoid of the jejunum and ileum; of these 236

were adenocarcinoma of the jejunum or ileum. Eger[5] collected 304 primary carcinomas of the duodenum and found 62 per cent in the second part, 24 per cent in the first part, 12 per cent in the third part and 2 per cent involving the entire duodenum and called attention to the duodenum being affected in 45 per cent of instances of primary carcinoma of the small intestine. Hoffman and Pack[13] in 1937 reported 238 cases of small intestinal carcinoma of which 45.6 per cent was in the duodenum. Fraser[14] reported thirteen cases, six carcinoma and seven sarcoma, among 22,975 operations on the gastrointestinal tract and 2,674 autopsies from the Western Infirmary, Glasgow, over a ten-year period.

In 1945 Shallow, Eger and Carty[15] reported a case of primary adenocarcinoma of the mid-jejunum and reviewed thirty-eight consecutive cases of histologically proven primary malignancy of the small bowel in the Jefferson Medical College Hospital. They made an exhaustive study of intestinal malignancies among 137,174 general autopsies collected from the literature from 1858 to 1938 and tabulated 5,034 in the large and 134 in the small intestine. This is an incidence of small intestinal malignancies of 0.1 per cent or about thirty-six times less frequent than large intestinal carcinoma. They listed the frequency of small intestinal malignancies among general intestinal malignancies and found that 3 per cent of intestinal carcinoma and 60 per cent of intestinal sarcomas occur in the small intestine. In surveying the incidence and distribution of carcinoma and sarcoma among primary small intestinal malignancies they tabulated 269 cases including their own thirty-eight. They found seventy-three carcinoma and twelve sarcoma in the duodenum; seventy-five carcinoma and twenty-one sarcoma in the jejunum; and thirty-eight carcinoma and fifty sarcoma in the ileum, e.g., 186 carcinoma and eighty-three sarcoma. They concluded that carcinoma is twice as common as sarcoma and that

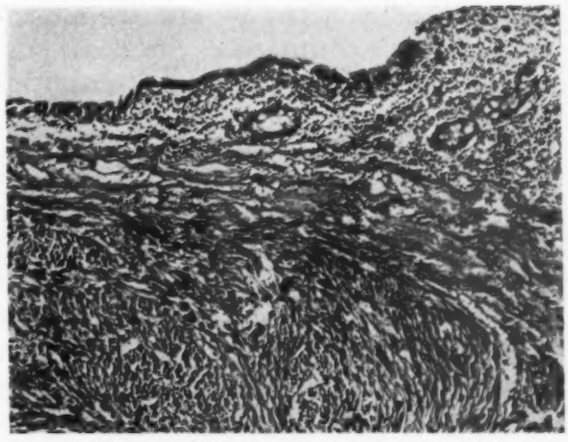


FIG. 13. Case IV. Microscopic appearance of leiomyosarcoma of ileum and sigmoid.

malignancy in general occurs with equal frequency in all three divisions of the small intestines, the ileum ranking lowest for carcinoma but highest for sarcoma. Ehrlich and Hunter[16] in a survey of 813 tumors arising in army personnel between eighteen and thirty-eight reported nine cases of primary carcinoma of the small intestine; eight of them were adenocarcinoma and one was a mucous cell carcinoma. Two arose in the duodenum, four in the jejunum and three in the ileum.

"Carcinoid" and the extremely rare type of melanocarcinoma of the small intestine are not included in this survey. Readers are referred to Dickson Parkhill and Kiernan's[17] paper in 1946 wherein they state that carcinoid tumors constitute a third of all malignant neoplasms of the small bowel and occur twice as frequently in the appendix than in the small bowel. They attribute to Oberndorfer the term "carcinoid" to express their malignant appearance in contrast to their benign course.

Pathologically, malignant tumors of the small intestine have been classified as (1) a stenosing napkin-ring like and constricting; (2) infiltrating—ulcerating, bulky, fungating and gelatinous papillary, and (3) polypoid, single or multiple and fungating. All three categories may be found in one case. With few exceptions malignant tumors of the small intestine begin as adenocarcinoma although medullary, scirrhous and colloid carcinoma have been reported. Sarcoma

may grow asymmetrically into the mesentery or into the peritoneal cavity (Case I) or readily become adherent and directly implant themselves into other viscera as in the colon (Case IV). Characteristically they generally grow circumferentially around the bowel wall, gradually occluding the lumen causing obstruction by cicatricial contracture. In rare instances the polypoid group, single or multiple, may be responsible for precipitating intussusception as portrayed in Case II. Kiefer and Lahey[4] believe that intussusception occurs in 30 per cent of tumors of the lower jejunum and ileum.

Malignant intestinal tumors arising from muscle are comparatively infrequent. Most writers consider all leiomyomas as benign and designate malignant tumors of the muscle as leiomyosarcoma. Klopp and Crawford[7] were able to find eighteen cases, thirteen were designated as occurring in the jejunum; four of these showed evidence of metastasis. They apparently develop slowly with a tendency to grow in bulk, degenerate and form cysts. Significantly they seldom occlude the lumen. They may extend outward into the mesentery crowding the visceral peritoneum and may attain an enormous size thus producing pressure on adjacent structures. X-ray may be of little value unless the tumor encroaches on the lumen. This description coincides with the gross findings in Case I. Most of Klopp and Crawford's[7] cases were known to arise from the longitudinal muscle coat and others from the circular layer. Most of them were firm, nodular and prone to degenerate. Harrington[18] in reporting a case of leiomyosarcoma of the duodenum observed that so few cases of primary sarcoma of the duodenum have been reported that it is impracticable to attempt to draw any conclusions regarding their pathologic pattern.

Small intestinal carcinoma metastasizes early; usually there is prompt extension and metastasis to the mesentery, regional lymph nodes, peritoneum, liver, lungs, brain, bone and skin. In Case III there was clinical evidence of metastasis to the brain and extensively generalized subcutaneous metastasis within a few weeks after resection. The direct extension into the mesentery so characteristically foreshortens the mesentery that effective radical excision of the disease is precluded. This accounts for the early recurrence.

Clinical Features. Tumors of the small intestine usually manifest themselves so insidiously that in their early formative stage they may mimic less serious gastrointestinal diseases. In most instances the patients present themselves with signs and symptoms of partial or complete obstruction of several days or weeks' duration. Frequently a history is elicited of vague, long-standing intermittent abdominal distress and fullness. There is a reluctance to eat because of the intestinal distress and distention that ensue. Nausea, weakness, asthenia, fatigue and loss of weight become increasingly more apparent. Occult blood may be detected in the stools. There is usually severe anemia from inadequate ingestion and absorption of food, absorption of toxic products of the carcinoma and loss of blood.

As the growth encroaches on the lumen and there is interference with the motility of the intestine and absorption of food, these symptoms become more acute. Severe intermittent pain, increasing nausea, vomiting and distention, and the classical symptoms and signs of intestinal obstruction become more evident as the disease progresses from partial to complete obstruction. As a result of the loss of fluid in the vomitus and into the distended bowel, there is a fall in blood chlorides, a rise in the non-protein nitrogen, some degree of alkalosis, dehydration and prostration. These findings become irreversible unless actively combated and the obstruction is relieved.

Not infrequently there is a history that the symptoms one or several months prior to admission prompted gastrointestinal x-ray studies which were variously diagnosed. Small intestinal fractional studies in early cases are notoriously difficult to

interpret. The more proximal the malignancy the sooner and more distressing the complaints and the more readily are the radiographic manifestations recognized. When the disease is complicated by intussusception as in Case III, the acute crisis necessitates immediate surgical intervention.

In the extrinsic malignant tumors the diagnosis is even more difficult and is rarely made preoperatively. Not until the expanding tumor encroaches on the lumen and adjacent structures or the effects of the ulcerating lesion demands operative interference, is the true nature of the disease ascertained. In a case of leiomyosarcoma of the duodenum, reported by Harrington, a woman thirty-eight years old, eight months before consultation at the Mayo Clinic, noticed generalized weakness and her physician recognized the anemia; three months later she had to relinquish her occupation as a school teacher. On admission to the clinic the hemoglobin was 38 per cent and erythrocytes 2,200,000. A stasis roentgenogram of the small bowel disclosed a flat polypoid type of lesion situated at the junction of the second and third portions of the duodenum, with an apparent central region of depression or ulceration. A diagnosis of a chronic bleeding lesion of the third portion of the duodenum was made. It was only after opening the abdomen that the true nature of the disease was determined. The history of Case I is somewhat similar. For five months he had increasing weakness. He was treated in another institution for duodenal ulcer. It was the progressive weakness and pain which ultimately necessitated surgical intervention and the true nature of the disease was ascertained, i.e., an extrinsic leiomyosarcoma of the duodenum.

The prognosis is grave because (1) the disease is rarely recognized before late manifestations have developed; (2) the roentgenologic diagnosis is difficult to establish in the early stages of the disease. Instances of early repeated negative interpretation of fractional small intestinal studies are recorded only to be diagnosed when the disease has advanced to the stage of partial or complete obstruction; (3) operation invariably discloses that the malignant process has invaded the lymphatics and resulted in a foreshortening of the mesentery; (4) the invasion of the rich lymphatics in the inaccessible upper segments of the mesentery results in early wide-spread metastasis and (5) radical extirpation of the diseased segment of the bowel and restoration of its continuity, while technically successful, is doomed to failure. Extirpation of the mesentery, which is foreshortened by the disease and the inaccessibility of the involved lymphatics, precludes a successful outcome as the disease has inevitably extended beyond the confines of the mesentery.

SUMMARY AND CONCLUSIONS

Four cases of malignant tumors of the small intestine have been presented. The underlying morbid process was different in each case. They illustrate the difficulty in early recognition and the reasons for the grave prognosis: (1) The early symptoms are vague intermittent abdominal distress and distention bearing no relation to meals; followed by progressive weakness and severe anemia; (2) radiographically early, the disease is variously diagnosed and a correct radiographic interpretation is rarely made before the onset of partial obstruction; (3) with the onset of obstruction the disease is generally too far advanced to achieve a successful outcome; (4) the disease frequently extends to the mesentery which is foreshortened; the lymphatic spread precludes radical extirpation of the inaccessible lymphatics; (5) metastasis and early recurrence within a few weeks to two years is to be expected if thorough extirpation of involved lymphatics cannot be effected; (6) the disease is resistant to radiotherapy.

Extirpation of malignant tumors of the small intestine, even in advanced stages, is attended with a relatively low immediate

operative mortality, therefore, earlier recognition of the disease may enhance the ultimate result. This may possibly be accomplished by (1) close evaluation of the history, (2) improvement in radiographic studies in order to ferret out the early intra- or extraluminary encroachments and (3) comprehensive repeated laboratory investigations particularly for occult blood in the stools and significant physiochemical changes in the blood in other than readily diagnosed entities.

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DOES THE BOWEL PREVENT THE OUTWARD DIFFUSION OF GAS FROM WITHIN THE BALLOON OF INTESTINAL TUBES?

AN EXPERIMENTAL STUDY

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IT has been unquestionably established that balloons of intestinal decompression tubes are permeable to intestinal gases.[1] Although we have developed a method of tying on the balloon of intestinal tubes so as to prevent the accumulation of gas within the balloons of intestinal tubes, cases are being reported in which, because of an error in applying the tie or as a result of a knot in a Miller-Abbott tube, a considerable distention of the balloon occurs. Several fatalities have been reported[2,3,4] because the surgeon failed to realize the significance of an increase in gas within the intestinal tube balloons or did not know how to contend with this complication.

In our studies upon the permeability of intestinal balloons to carbon dioxide gas and hydrogen sulfide gas we were able to show *in vitro* that if the bowel circumjacent to the balloon is decompressed, the gas within the balloon would diffuse out. The diffusion outward of the hydrogen sulfide is very rapid, occurring in a matter of minutes. Carbon dioxide, although it diffuses out much slower, will nevertheless completely diffuse out of balloons exposed to the air in less than twenty-four hours. Since these studies were carried out *in vitro* by exposing the balloons to atmospheric air and since only carbon dioxide and hydrogen sulfide were used, the question arose as to whether the same findings would hold true for balloons within the intestinal tract and for balloons filled with air.

The great importance of such studies is quite apparent in that we would then be in a position to tell the surgeon with a definite degree of certainty just what to expect when roentgenograms disclosed a balloon distended with gas. Very often the first indication that the surgeon has that something unusual has occurred is the cessation of suction decompression in the case of the Miller-Abbott tube or the inability on the part of the surgeon to remove the Harris intestinal decompression tube.[5]

This experimental study was divided into four parts and an effort made to reproduce *in vivo* conditions as closely as possible.

METHOD

Experiment No. 1. This experiment has as its purpose to show the effect of fluid in contact with the balloons of intestinal tubes upon the permeability of the balloons to various gases. Twelve balloons were used in this study. The volume of gas in the balloon was measured by the water displacement method.

Air-filled Balloons

	cc.
1. Cantor balloon (latex)	22
2. Cantor balloon (neoprene)	35
3. Harris balloon	117
4. Miller-Abbott balloon	61

Carbon Dioxide-filled Balloons

1. Cantor balloon (latex)	33
2. Cantor balloon (neoprene)	64
3. Harris balloon inflated	254
4. Miller-Abbott balloon	90

Hydrogen Sulfide-filled Balloons

1. Cantor balloon (latex)	17
2. Cantor balloon (neoprene)	47
3. Harris balloon inflated	182
4. Miller-Abbott balloon	64

These balloons were then submerged in shallow pans containing water. The balloons were completely covered by the

water. Seven thousand cc. of water at 13°c. were used in each pan. Three pans were used, one for each group of four balloons. At the end of three hours all the balloons were examined and then at the end of twenty-four hours all the balloons were re-examined.

RESULTS

At the End of Three Hours. At the end of three hours the results were as follows:

Air-filled Balloons

	cc.
1. Cantor balloon (latex)	22
2. Cantor balloon (neoprene)	35
3. Harris balloon	117
4. Miller-Abbott balloon	61

A comparison of these values at the end of the three-hour period with those at the beginning of the experiment shows no loss of air from any of the balloons.

Carbon Dioxide-filled Balloons

	cc.
1. Cantor balloon (latex)	3
2. Cantor balloon (neoprene)	53
3. Harris balloon	24
4. Miller-Abbott balloon	6

A comparison of these values with those at the beginning of the experiment shows a considerable loss of carbon dioxide from all the latex balloons but only a small loss from the neoprene balloon. The actual loss of carbon dioxide gas from each balloon is as follows: Cantor latex balloon showed a loss of 30 cc. or 90 per cent of its gas; Cantor neoprene balloon showed a loss of 11 cc. or 17 per cent of its gas; Harris balloon showed a loss of 230 cc. or 90 per cent of its gas; Miller-Abbott balloon showed a loss of 84 cc. or 93 per cent of its gas.

Hydrogen Sulfide-filled Balloons

	cc.
1. Cantor balloon (latex)	3
2. Cantor balloon (neoprene)	28
3. Harris balloon	8
4. Miller-Abbott balloon	8

A comparison of these values with those at the beginning of the experiment shows a marked loss of hydrogen sulfide gas from all the latex balloons but again only a small loss from the neoprene balloon. The actual loss of hydrogen sulfide gas from each balloon is as follows: Cantor latex balloon showed a loss of 14 cc. or 82 per cent of its gas; the Cantor neoprene balloon showed a loss of 19 cc. or 40 per cent of its gas; the Harris balloon showed a loss of 174 cc. or 95 per cent of its gas; the Miller-Abbott balloon showed a loss of 56 cc. or 87 per cent of its gas.

At the End of Twenty-four Hours. At the end of twenty-four hours all these balloons were re-examined. It was now found that all the balloons filled with air had lost no gas. The balloons filled with hydrogen sulfide and those filled with carbon dioxide were found to be completely empty.

These results when compared with our previous studies[6] upon the diffusion of gases from within the balloons when exposed to air show essentially the same speed of loss of the various gases. It is thus evident that the submersion of the balloons in water does not in any way change the speed of diffusion of the various gases. It must also be noted that within the twenty-four-hour period there was no diffusion of the air-filled balloons through the walls of the balloon. This observation is important in the light of the many observations that air can be found within the balloons of intestinal tubes as well as the fact that in the Miller-Abbott tube the balloon is deliberately filled with air for the purposes of propulsion. The presence of a safety valve by tying the balloons on over a 22 French stylet in a Cantor tube of 18 French luminal diameter would effectively prevent this occurrence since the air could readily escape through the vent that was left when the stylet was removed after the application of the tie was completed.

Experiment No. 2. This experiment had as its purpose to show the effect of the close approximation of the human bowel wall to the distended balloon upon various gases trapped within the balloon. Ten balloons were used in this experiment. The balloons were divided into three groups. The first

group of four balloons were filled with air, the second group of three balloons were filled with carbon dioxide and the third group of three balloons were filled with hydrogen sulfide gas. All balloons were carefully sealed after being filled to prevent loss of gas from the mouth of the balloon. Each group was then inserted into a 12 inch length of small intestine taken from a human autopsy one hour previously. The bowel wall was markedly distended by the inflated balloons so that a very close approximation between the balloons and bowel wall obtained. The ends of the bowel were then tied off and the sections of bowel submerged in a pan containing 7,000 cc. of normal saline at 13°C. Three pans were used for this purpose, each group being kept in a separate pan.

Air-filled Balloons

	cc.
1. Cantor neoprene balloons	36
2. Cantor latex balloons	23
3. Harris balloon	119
4. Miller-Abbott balloon	64
Carbon Dioxide-filled Balloons	
1. Cantor neoprene balloon	26
2. Harris balloon	125
3. Miller-Abbott balloon	53
Hydrogen Sulfide-filled Balloons	
1. Cantor neoprene balloon	27
2. Harris balloon	76
3. Miller-Abbott balloon	41

RESULTS

At the End of Three Hours. All the air-filled balloons, Cantor neoprene, Cantor latex, Harris and Miller-Abbott showed no change at the end of three hours. It is obvious from this examination that there has been no outward diffusion from within any of the balloons.

Carbon Dioxide-filled Balloons

	Per cent of Gas Remaining
1. Cantor neoprene balloon	75
2. Harris balloon	25
3. Miller-Abbott balloon	25

Here again we see that the Cantor neoprene balloon has lost only one-fourth of its gas whereas the latex Harris balloons and the latex Miller-Abbott balloons have lost three-fourths of their gas. This is a definite index of the comparative permeabilities of neoprene and latex.

Hydrogen Sulfide-filled Balloons

	Per cent of Gas Remaining
1. Cantor neoprene balloon	50
2. Harris balloon	25
3. Miller-Abbott balloon	25

The water in which this segment of bowel was immersed had become milky like that in which the hydrogen sulfide-filled balloons without the bowel had been immersed. It is evident that the hydrogen sulfide gas diffuses rapidly not only through the balloons but also through the bowel wall. Again the neoprene balloon is seen to be much less permeable than the latex balloons.

At the End of Twenty-four Hours. At the end of twenty-four hours the air-filled balloons had shown no loss of air. The carbon dioxide and the hydrogen sulfide gas-filled balloons had lost all their gas and were now found to be empty.

Experiment No. 3. This experiment had as its purpose to show the effect of the close approximation of the human bowel containing intestinal contents taken from a case of bowel obstruction upon the outward diffusion of gases trapped within the balloons of intestinal tubes. In this experiment the inflated balloons were tied off and then inserted into 12 inch lengths of human small intestine taken from a one hour old autopsy. Three sections of human bowel were used in this experiment. The distended balloons caused a marked stretching of the bowel wall which closely approximated the balloon. The bowel was then filled with intestinal secretion taken from a case of bowel obstruction. Since we had amply demonstrated that the outward diffusion of air was negligible in the twenty-four hour period, we decided to omit the air-filled balloons in the experiment. We used only Harris balloons and neoprene Cantor balloons because the behavior of the Harris latex balloon is exactly the same as that of the latex Miller-Abbott. Since the Cantor latex balloon is now re-

placed by the Cantor neoprene balloon, we decided to use the new Cantor neoprene balloons.

Carbon Dioxide-filled Balloons

	cc.
1. Harris balloon filled	90
2. Cantor neoprene balloon	26

Hydrogen Sulfide-filled Balloons

1. Harris balloon	92
2. Cantor neoprene	33

RESULTS

At the End of Three Hours. At the end of three hours the results were as follows:

Carbon Dioxide-filled Balloons

1. Harris balloon	50% of gas remaining
2. Cantor neoprene balloon	90% of gas remaining

A comparison of these values with those at the beginning of the experiment demonstrates rather conclusively that the neoprene under these conditions is much less permeable than the latex.

Hydrogen Sulfide-filled Balloons

1. Harris balloon	25% of gas remaining
2. Cantor neoprene balloon	75% of gas remaining

Here again we note that hydrogen sulfide is much more diffusible than was the carbon dioxide, and that the neoprene balloon is far less permeable than the latex.

At the End of Twenty-four Hours. All the balloons containing carbon dioxide and hydrogen sulfide gas were found to be completely empty.

Experiment No. 4. The purpose of this experiment was to determine whether intestinal secretions alone could cause gas to diffuse into balloons of intestinal tubes. For this experiment 400 cc. of intestinal contents removed from a case of bowel obstruction was used. Two balloons containing mercury were tied off and then submerged in this juice for twenty-four hours and examined for gas.

Results. An examination of the balloons at the end of twenty-four hours showed no gas within the balloons. An examination at the end of forty-eight hours had similarly shown the balloons to be empty.

SUMMARY

The effect of submersion of balloons of intestinal decompression tubes inflated with different gases in water was studied and compared with similar studies in which the inflated balloons were exposed to air. The experiment indicated that there was very little or no difference in the speed of diffusion of the gases from within the balloons exposed to air or submerged in water. In reproducing *in vivo* conditions the inflated balloons were inserted within the intestinal tract of an hour-old autopsy specimen. The inflated balloon caused the bowel wall to be stretched tightly over it. We noted that the speed of diffusion of the gases out of the balloons was the same whether the bowel was empty or filled with intestinal secretions. There appeared to be very little difference between the speed of diffusion of gases out of the balloons within the bowel or those submerged in liquid or exposed to air.

This experimental study clearly shows that if an intestinal decompression tube balloon becomes inflated as a result of carbon dioxide or hydrogen sulfide, the passage of a second intestinal tube to decompress the circumjacent bowel would rapidly result in the diffusion of the hydrogen sulfide or the carbon dioxide from within the balloon into the bowel. The speed of diffusion of the hydrogen sulfide is so fast that it is extremely doubtful whether this gas enters into the problem at all. The only possible influence this gas might have is suggested by our observations that balloons filled with hydrogen sulfide rapidly lost this gas in less than four hours. If then these balloons were permitted to lie exposed to the air, they took up some of the air. This diffusion of air into balloons formerly filled with hydrogen sulfide might constitute a real problem in intubation, or the presence of an air-filled Miller-Abbott balloon which could not be evacuated as a result of a knot in the tube might be quite serious for the patient. The reason for this is obvious from our observations that the air-filled balloons showed very little or no change in twenty-four hours. Some balloons filled with air were observed for four days and were then noted

to show very little if any loss of air. When we recall that approximately 80 per cent of the air consists of nitrogen, a gas which is extremely slowly diffusible through a rubber membrane, it becomes obvious why this should be so. Once air has accumulated within the intestinal tube balloons many days of bowel decompression are required before any appreciable loss of air occurs from the balloon. The best treatment for this unusual accident is to prevent it by the use of a No. 18 French lumen tube and a safety valve vent as described in an earlier publication.[1]

CONCLUSIONS

1. The speed of outward diffusion of hydrogen sulfide and carbon dioxide from within the balloons of intestinal decompression tubes is not influenced by the media in which they occur. Exposure to air, submersion in water, insertion within the empty bowel or insertion within the bowel filled with intestinal secretion does not result in any change in the speed of diffusion of the gas under the same conditions of temperature and pressure.

2. Hydrogen sulfide gas is most rapidly diffusible from the balloons, so much so in fact, that it is highly improbable that this gas is a factor in this problem.

3. Neoprene balloons are far less permeable than are latex balloons.

4. Submersion of balloons containing mercury in intestinal secretions for twenty-four hours does not result in any gas intake.

5. The best treatment for this complication is prevention. Should this accident occur, adequate decompression of the bowel will generally result in the inflated balloon losing sufficient air so that it can be excreted per rectum.

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FURTHER STUDY OF THE SUSPENSORY MUSCLE OF THE DUODENUM*

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A REPORT was made previously[1] of a study of the suspensory muscle of the duodenum in seventy-seven cadavers. In this work we attempted to determine the attachments of this structure, especially its precise attachments to the duodenum. We also attempted to determine the percentage of instances in which muscle tissue could be demonstrated in it and to determine what kind of muscle it was.

By gross examination we found that in 5.2 per cent of the specimens the fibers were attached solely to the duodenojejunal flexure; in 61 per cent they were attached to the flexure and to the fourth and third parts of the duodenum, and 15.6 per cent they were attached to the fourth and third parts of the duodenum with no attachments to the flexure. In 18.2 per cent of the specimens this structure could not be demonstrated.

In 31.2 per cent of the specimens muscle fibers appeared to be present from gross examination while in 50.6 per cent one could not determine whether or not muscle fibers were present.

By microscopic examination we found muscle fibers present in 90 per cent of the specimens in which they appeared to be present by gross examination, and in 80 per cent of the specimens in which it could not be determined by gross examination whether or not they were present. In all cases we found the muscle tissue to be of the smooth type.

Purpose of Present Study. In this series of specimens we have continued the study that was made in the previous series. In the previous study, however, only a qualitative examination was made while in this one both qualitative and quantitative estimations were made, and the qualitative study was made in much more detail.

Procedure. Grossly, the muscle, (or ligament), in sixty-four human cadavers was cleaned, measured and removed with the duodenum after noting carefully the origin and insertion. Careful examination was made to determine whether or not muscle fibers could be detected grossly.

RESULTS

Gross Findings. In fifty-seven (89 per cent) of our specimens, either a muscle or a ligament could be definitely demonstrated while in seven (11 per cent) neither could be found.

Attachment of the structure to the duodenum can be tabulated as follows in Table 1:

TABLE 1

	No.
Attached to flexure only and with muscle fibers apparent	1
Attached to flexure only and with no muscle fibers apparent	4
Attached to flexure and to 3rd and 4th parts of duodenum and with muscle fibers apparent	14
Attached to flexure and to 3rd and 4th parts of duodenum and with no muscle fibers apparent	10
Attached to flexure and to 2nd, 3rd and 4th parts of duodenum and with muscle fibers apparent	4
Attached to flexure and to 2nd, 3rd and 4th parts of duodenum and with no muscle fibers apparent	4
Attached to 3rd and 4th parts of duodenum only and with muscle fibers apparent	11
Attached to 3rd and 4th parts of duodenum only and with no muscle fibers apparent	9

From the above tabulation it can be seen that in only five (8.8 per cent) of these

*This study was made possible by funds contributed by the M. D. Anderson Foundation.

FIG. 1. Drawing showing attachment of the suspensory muscle to the duodenojejunal flexure; specimen No. 5.

FIG. 2. Drawing showing attachment of the suspensory muscle to the fourth part of the duodenum and the duodenojejunal flexure; specimen No. 42.

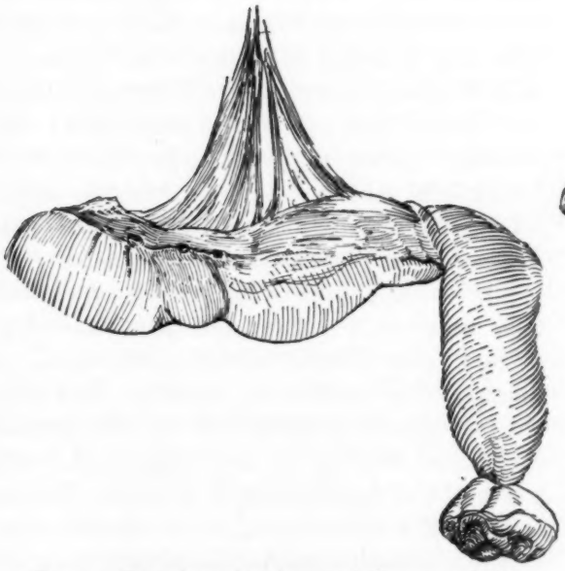

FIG. 3. Drawing showing attachment of the suspensory muscle to the third and fourth parts of the duodenum; specimen No. 19.

FIG. 4. Drawing showing attachment of the suspensory muscle to the second, third and fourth parts of the duodenum; specimen No. 28.

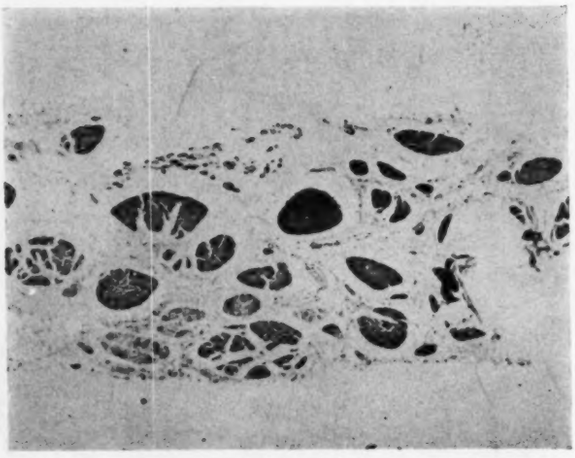

FIG. 5. Photomicrograph of a transverse section of the suspensory muscle of the duodenum showing scattered fascicles of smooth muscle enmeshed in loose connective tissue; specimen No. 46; Van Gieson's stain; × 100.

specimens in which a definite anatomic structure could be demonstrated was this structure attached to the flexure only, while in fifty-two (91.2 per cent) it was attached to either the second, third or fourth parts of the duodenum or to combinations of these parts. (Figs. 1 to 4.)

Likewise, it can be seen that in thirty (52.6 per cent) of the specimens in which a definite anatomic structure could be demonstrated muscle fibers were apparent grossly, while in twenty-seven (47.4 per cent) it could not be determined grossly whether or not muscle fibers were present. The length of the structure was usually found to be 7 to 11 cm.

MICROSCOPIC STUDY

Microscopic Methods. Histologic preparations were made of fifty-five of the fifty-seven dissected specimens. Following embedding in paraffin and sectioning at 10 micra (largely transversely but in a few instances longitudinally), each fifteenth consecutive section was mounted and stained with Delafield's hematoxylin and eosin. In order to reduce any error in the differentiation of muscle and collagenous tissue six of the specimens were stained with Van Gieson's method. Selected sections of eleven specimens were stained with MacCallum's elastic tissue stain so as to check for the presence of elastic tissue. In

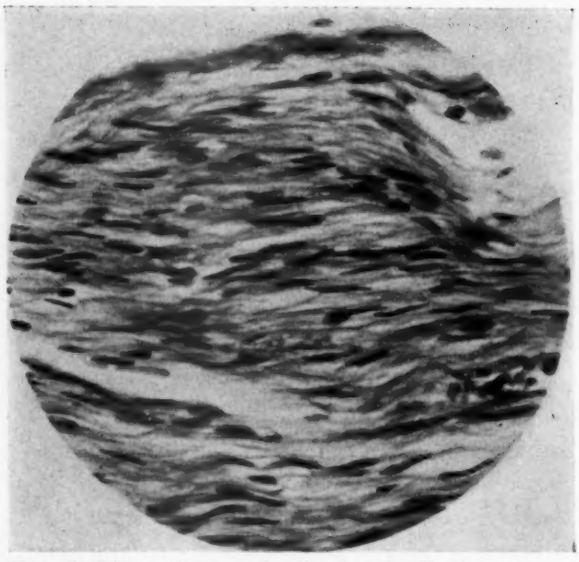

FIG. 6. Photomicrograph of a longitudinal section of the suspensory muscle of the duodenum showing smooth muscle cells; specimen No. 7; hematoxylin-eosin stain; × 900.

several instances microprojection tracings of the smooth muscle and connective tissue components were made and the cross sectional areas measured with a planimeter. In this manner reasonably exact ratios of these two types of tissue were established.

Microscopic Study. Histologic preparations have shown that we are dealing with a structure composed of smooth muscle and loose connective tissue. (Figs. 5 and 6.) The ratio of these two principal components has been found to be variable, both as regards different muscles at comparable levels and in individual muscles at different levels. It was found that smooth muscle fibers were present in forty-eight (87.3 per cent) of the specimens that were examined microscopically. No smooth muscle was found in seven (12.7 per cent) of the cases.

The foregoing data express in a quantitative manner a conclusion that had been gained from simple observation of all the histologic preparations, namely, that when the structure is attached to the second, third and fourth, or the third and fourth parts of the duodenum, it is largely muscular. On the other hand, cases having most of their attachment to the duodenojejunal flexure show a preponderance of connective tissue and a paucity of smooth muscle.

From Table II it can be seen that the suspensory muscle becomes progressively less muscular as sections are taken farther away from its duodenal attachment and closer to its diaphragmatic attachment. At the same time the connective tissue component increases in amount. Ultimately the latter blends with the fibrous tissue of the right crus of the diaphragm.

TABLE II

Specimen No.	Duodenal Attachment	Distance of Section from Duodenum (mm.)	X-Section Area in Sq. mm.	
			Smooth Muscle	Connective Tissue
42	4 Flexure	21	14.68	4.89
42	4 Flexure	43	9.05	6.08
42	4 Flexure	62	1.43	12.08
28	2, 3, 4	25	17.45	3.95
28	2, 3, 4	53	7.13	6.15
5	Flexure	16	4.21	9.53
5	Flexure	46	0.61	6.55
19	3, 4	24	13.88	3.79
25	3, 4	24	9.53	2.87
37	2, 3	21	12.01	4.25

There is some considerable variation in the total cross sectional area of different specimens. Thus, sections taken from comparable levels have been found to vary from 21.40 sq. mm. in the case of specimen No. 28, to 12.40 sq. mm. in specimen No. 25. Qualitative examination of all specimens leads one to expect that had it been practical to make planimeter measurements of all cases this range of variation would be found to be greater than even the foregoing data show.

Planimeter measurements of the cross sectional area of a part of the circumference of the duodenum indicate that the total cross sectional area of smooth muscle in the wall of the duodenum at sites of attachment would range from 140 to 180 sq. mm. From the foregoing data (Table II) it is evident that in some cases the suspensory muscle would be capable of developing tension approximately one-tenth that of the duodenal musculature.

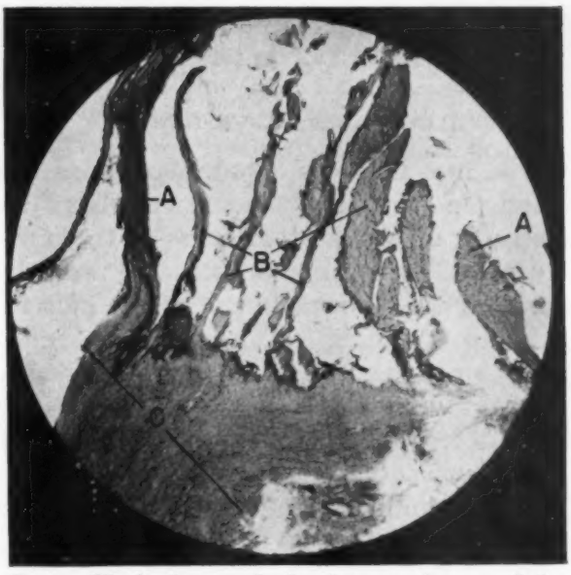

FIG. 7. Photomicrograph showing attachment of the suspensory muscle to the duodenum. A, fibers derived from the longitudinal layer of the muscularis externa; B, fibers derived from the circular layer; C, muscularis externa of the duodenum; specimen No. 46; Van Gieson's stain; × 100.

In some cases the muscle was sectioned parallel to the course of the fibers. Some specimens with relatively few muscle bundles permitted measurement of the length of the individual fibers. They were found to range in length from 92 to 242 micra.

The smooth muscle bundles are derived from both longitudinal and circular layers of the duodenum. Study of transverse sections of the duodenum at the site of attachment shows that the circular coat contributes more fibers to the suspensory muscle than does the longitudinal layer. (Fig. 7.)

The connective tissue component was invariably loosely arranged except in a few instances at the diaphragmatic end. The compact collagenous bundles seen in these cases are probably due to some of the crus being inadvertently excised with the muscle. Considering individual types of connective tissue, collagenous fibers were found to predominate. A few elastic fibers were found in the sections stained according to the method of MacCallum. A small

amount of adipose tissue was associated with the vessels supplying the muscle.

BLOOD AND NERVE SUPPLY

The blood vessels are derived from the inferior pancreaticoduodenal vessels as the latter lie in the interval between the muscularis externa and submucosa of the duodenum near the attachment of the muscle.

Small bundles of myelinated nerve fibers have been found in many specimens. Probably they are preganglionic vagus fibers. One would infer from the relation of the suspensory muscle to the gut musculature that the innervation would be comparable.

COMMENT

It is frequently stated[2] that the suspensory muscle is present and well developed in childhood and early adulthood, after which time the structure suffers atrophic changes with the result that its identity is lost in the loose connective tissue of the region.

We were unable to corroborate such a view. In the gross study, 89 per cent of the cases showed the presence of a definite anatomic structure and 87.3 per cent of these cases that were examined microscopically showed muscular tissues present. None of the specimens studied was under thirty-eight years of age while most of them were above fifty years of age.

In a roentgenographic study of 450 hospital patients Friedman[3] has shown that with advancing age the third part and duodenojejunal flexure remain relatively fixed, whereas the first part becomes progressively lower, and the second part becomes shorter and shifts toward the right. These observations are readily understood in view of our finding the suspensory muscle present in such a large percentage of the cases. The presence of a definite structure attached in whole or in part to the third and fourth parts of the duodenum and its flexure with the jejunum fits well with Friedman's observation of the constancy of position of those parts over a wide age range.

Because of the nature of our material we have been unable to make a detailed correlation of the degree of development of the suspensory muscle with age. However, the considerable variation in muscularity seen in specimens of a restricted age range suggests that age is not a prime factor in the amount of development shown by the structure.

In view of our findings regarding the attachments of the muscle to the duodenum, some deductions regarding the functional attributes of the structure may be made. When it is attached to the second, third or fourth parts separately or in combination the angle between the duodenum and jejunum will be increased as the muscle contracts. In these studies we have consistently observed that the best muscularized specimens are attached to these parts. Planimeter measurements of the cross sectional area of a part of the circumference of the duodenum permitted an estimate of the total cross sectional area of the muscularis of the duodenum within the range of 140 to 180 sq. mm. Since muscle strength is a function of its cross sectional area, data in Table II show that in some cases the suspensory muscle would be capable of developing tension approximately one-tenth that of the duodenal musculature. There is thus the probability that the suspensory muscle is capable of decreasing the acuteness of the duodenojejunal flexure.

In the event the structure is attached principally to the flexure, it is evident that shortening would decrease the angle and contribute to obstruction. In our cases, however, there was so little muscle in specimens with this attachment, it is doubtful that obstruction could be contributed to in this manner. On the other hand, we have noted that when the muscle is attached to the flexure alone (8.8 per cent of the cases), it is shorter than in cases with other attachments. Probably not all of this is associated with duodenal topography. If this interpretation is correct, the

suspensory muscle in such instances would contribute to obstruction by kinking the flexure. (Fig. 5.) Indeed, Crosthwait[5] reports success in relieving duodenal obstruction by means of a procedure which includes doing a plastic operation on the suspensory muscle so as to increase its length.

The authors wish to thank Dr. P. A. Wheeler, Department of Pathology, Baylor University College of Medicine, for helpful suggestions regarding histologic technic. For skillful preparation of the material for histologic study we are greatly indebted to Miss Virginia Woolridge, technician in the Department of Anatomy. We also wish to thank Mrs. Ella May Shackelford Breckenridge of the Department of Visual Education for the drawings, and Mr. F. C. Breckenridge of the same department for the photography. The expenses incurred in the study were defrayed by a grant from the M. D. Anderson Foundation to which grateful acknowledgment is made.

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Although primary hemangioma of a muscle is very rare, one occasionally encounters it in a skeletal muscle. There is a localized tumor having a rubbery feeling that is painful and which usually is intensified by movement of the muscle involved. There is also marked local tenderness and often a sensation of pulsations as well. The growth usually involves one of the muscles in a lower extremity. This condition undoubtedly is congenital but may be greatly aggravated by local trauma. Rhabdomyoma, hydatid cyst, fibroma or neurofibroma, fibrosarcoma, hematoma, myoblastoma or lipoma are a few of the other leading primary growths found in muscles. Primary hemangioma can be differentiated from the aforementioned by x-rays since 50 per cent of the patients show phleboliths, and by exploratory needle-puncture of the swelling in which practically 100 per cent of the patients demonstrate the presence of blood. (*Richard A. Leonardo, M.D.*)

CHOLECYSTOSTOMY*

A STUDY OF PATIENTS TEN TO SIXTEEN YEARS LATER

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IT is generally agreed that cholecystectomy is the operation of choice for cholecystitis with cholelithiasis. Yet cholecystectomy may be unnecessarily hazardous if the general condition of the patient is critical or if inflammation in and about the gallbladder makes accurate identification of the structures at the cystic-common duct junction impossible. The increasing number of traumatic strictures of the common duct indicate that too many cholecystectomies are being performed without good visualization of the cystic and common ducts. Where such visualization is impossible, good surgical judgment dictates cholecystostomy. Because of the advancing span of life severe degenerative lesions will more frequently complicate biliary tract disease. In such instances extensive operations for acute cholecystitis may be unnecessarily hazardous. Here, also, cholecystostomy has a place.

Some surgeons report a higher operative mortality in cholecystostomy than in cholecystectomy. Such comparisons are misleading because cholecystostomy has generally been used in the patient who is a poor risk. In comparable patients it is only reasonable to believe that cholecystectomy, which requires general or spinal anesthesia, better exposure, more extensive dissection and longer operating time, will result in a higher operative mortality than cholecystostomy, an operation which can be performed if necessary under local anesthesia. The greater immediate risk of cholecystectomy must be carefully weighed against the smaller chance of cure and the need of secondary operations when cholecystostomy is used.

The extent to which removal of the gallbladder increases the operative risk depends on the patient's condition, the skill of the surgeon and the operating facilities—variables difficult to measure. Although the immediate risks of cholecystostomy are smaller, the danger of incomplete cure is real. If a surgeon knew exactly what to expect from drainage of a diseased gallbladder, he could better gauge the need of risking cholecystectomy in the individual patient.

There are many reports of "end-results" in patients who have had cholecystostomies, but it seems to us that either too few patients were followed or that the follow-up period was too short for proper evaluation.

Cholecystostomies are being performed with less and less frequency on the Surgical Service of the Hospital of the University of Pennsylvania. Only when the patient is in extremely poor condition or when identification of the ducts is impossible is cholecystectomy abandoned, and subsequent cholecystectomy is always advised if the patient's general condition is satisfactory. Cholecystostomy is almost never done for chronic cholecystitis. The change in policy has been a gradual development. During the period 1931 through 1936 the indications for cholecystostomy were broader than at present, and most patients operated upon for acute cholecystitis and some patients with chronic cholecystitis were treated by cholecystostomy.

In an attempt to ascertain the long term morbidity following cholecystostomy, an analysis was made of all patients from the surgical wards of the Hospital of the University of Pennsylvania on whom this operation was performed during the six

* From the Surgical Clinic of the Hospital of the University of Pennsylvania, Philadelphia, Pa.

years between January 1, 1931, and January 1, 1937. One hundred six patients clearly had disease of the gallbladder and comprise the group for study. Of these, five patients died in the hospital, giving an operative mortality of 4.7 per cent. Of the

TABLE I
AGE AT TIME OF CHOLECYSTOSTOMY
EIGHTY-FOUR PATIENTS

Decade*	No.	Per cent
10–19	0	0
20–29	3	4
30–39	16	19
40–49	22	26
50–59	18	21
60–69	19	23
70–79	6	7

* Average age—forty-nine years

remaining 101 patients, it was possible through questionnaires, personal examinations and interviews with family physicians to obtain an accurate follow-up on eighty-four patients or 84 per cent. Patients were followed either until death or for periods varying from ten to sixteen years.

ANALYSIS OF DATA ON EIGHTY-FOUR PATIENTS WITH CHOLECYSTOSTOMY FOLLOWED UNTIL DEATH OR FOR MORE THAN TEN YEARS

Tables I and II give the age at operation and the sex incidence of the group. More than half the patients were over fifty years of age and less than a quarter were under forty years. The high average age—forty-nine years—is explained by the fact that even in this early period most of the younger patients requiring biliary tract surgery were treated with cholecystectomy. As would be anticipated, more than two-thirds of the group were females.

Table III gives the pathologic process encountered at operation. Sixty-five patients (77 per cent) had acute cholecystitis with cholelithiasis, nine with stones in the common duct. Eighteen patients (22 per cent) had chronic cholecystitis, eight with stones in the common duct. The high incidence of patients with chronic cholecystitis reflects the broad indications for cholecystostomy at this hospital from 1931 to 1936. The remaining patient, who had carcinoma of the head of the pancreas involving the gallbladder, died of metastases three months after operation and is not considered in subsequent tables.

TABLE II
SEX INCIDENCE OF EIGHTY-FOUR CHOLECYSTOSTOMY PATIENTS

Sex	No.	Per cent
Female	60	71
Male	24	29

The long term results of cholecystostomy in the eighty-three patients are shown in Table IV. Satisfactory results were obtained in only 67 per cent. Thirty-nine patients had complete relief from the symptoms of gallbladder disease for periods ranging from ten to sixteen years or an average of thirteen years. Seventeen patients died of causes not related to biliary tract disease on an average of five years after operation. As far as could be determined from interviews with these patients' families and physicians, they were free of all gallbladder symptoms subsequent to cholecystostomy. One-half of the deaths were due to cardiovascular disease and the rest to miscellaneous

TABLE III
PATHOLOGIC PROCESSES FOUND AT OPERATION ON EIGHTY-FOUR CHOLECYSTOSTOMY PATIENTS

Pathologic Process	No.	Per cent
Acute cholecystitis with cholelithiasis	56	66.6
Acute cholecystitis with cholelithiasis and choledocholithiasis	9	10.7
Chronic cholecystitis with cholelithiasis	10	12.0
Chronic cholecystitis with cholelithiasis and choledocholithiasis	8	9.5
Carcinoma of the head of pancreas involving gallbladder with cholelithiasis	1	1.2

causes. It seems reasonable to include these seventeen patients as satisfactory results from cholecystostomy.

The number of unsatisfactory results were high, namely, one-third of the total group. Five patients died of disease originating from cholecystitis and cholelithiasis. Symptoms persisted in the remaining twenty-two patients, almost all of whom were advised to return for cholecystectomy. Seven have refused to return for operation and continue to report symptoms. Sixteen subsequently returned for cholecystectomy and were operated on without a death. It is interesting to note that all but two of the secondary operations for gallbladder removal were performed within the first year after cholecystostomy.

In Table v a detailed breakdown of long term results is given in the acute group and

TABLE IV

RESULTS OF CHOLECYSTOSTOMY IN EIGHTY-THREE PATIENTS WITH CHOLECYSTITIS AND CHOLELITHIASIS FOLLOWED UNTIL DEATH OR FOR MORE THAN TEN YEARS*

Results	No. of Patients	Per cent	Period of Time
Satisfactory	56	67	
Symptoms completely relieved	39	47	Average follow-up 12.8 years (minimum 10 years)
Death from unrelated cause	17	20	Average of 5.4 years after operation
Unsatisfactory	27	33	
Symptoms persisted	6	7	Average follow-up 13 years
Symptoms persisted requiring secondary cholecystectomy	16	20	Average of 1.1 years after operation
Death from related cause	5	6	Average of 4 years after operation

* Including seventeen patients with combined choledocostomy and cholecystostomy

TABLE V

RESULTS OF CHOLECYSTOSTOMY IN SIXTY-FIVE PATIENTS* WITH ACUTE AND EIGHTEEN PATIENTS† WITH CHRONIC CHOLECYSTITIS AND CHOLELITHIASIS

Results	Acute			Chronic		
	No.	Per cent	Period of Time	No.	Per cent	Period of Time
Satisfactory	43	66	.....	13	72	
Symptoms completely relieved	32	49	Average 13 years	7	39	Average 12.5 years
Death from unrelated cause	11‡	17	Average 5.8 years	6‖	33	Average 5 years
Unsatisfactory	22	34	.....	5	28	
Symptoms persisted	5	8	Average 13 years	1	6	13 years
Symptoms persisted requiring secondary cholecystectomy	15	23	Average 1.1 years	1	6	6 months
Death from related causes	2§	3	.....	3¶	16	

* Including nine patients with combined choledocostomy and cholecystostomy

† Including eight patients with combined choledocostomy and cholecystostomy

‡ Heart failure, five; cerebral accident, three; tuberculosis, one; kidney disease, one; carcinoma colon, one

§ (1) Cholangitis two years after operation; (2) recurrent attacks acute cholecystitis, two subsequent cholecystostomies, the last fatal

‖ Heart failure, two; carcinoma stomach, one; carcinoma esophagus, one; cerebral accident, one; fracture hip, one

¶ All from recurrent cholangitis, occurring four, five and eight years, respectively, after cholecystostomy

in the chronic group. The percentage of satisfactory results was not significantly different for the two groups. It should also be noted that both Table IV and V include seventeen patients who had combined choledocostomy and cholecystostomy. Because the results of the combined operation were essentially the same as of cholecystostomy alone, the two groups have been consolidated in the tables. Fifteen of the seventeen who had the combined operation were jaundiced at the time of the original procedure and represent all the jaundiced patients in the entire series. The follow-up study of the fifteen jaundiced patients showed that nine were completely relieved of all symptoms; that four died of unrelated causes without further biliary tract symptoms; and that two died of causes related to biliary tract disease. Both deaths were due to recurrent cholangitis and occurred four and five years, respectively, after the original operation. Secondary cholecystectomy, which would have prevented reformation of gallstones if combined with thorough exploration of the common duct, might have prevented both deaths.

COMMENTS

Although the number of patients in this study is small, it is believed the long follow-up period allows certain definite conclusions. The authors made the study after noting that several patients who had cholecystostomies in the Hospital of the University of Pennsylvania refused to return for cholecystectomy because they were completely relieved of symptoms. An effort to determine the exact long-term results of cholecystostomy seemed indicated.

The percentage of satisfactory results, 67, is a generous estimate because it is probable that some of the patients who are tabulated as "unrelated deaths" were not free from gallbladder symptoms although we were unable to get a positive history from their families or physicians. Clearly the long-term results after cholecystostomy leave much to be desired.

The finding of greatest importance was that five patients subsequently died of disease originating in cholecystitis with cholelithiasis. Four had recurrent attacks of cholangitis which accounted for their deaths. The fifth continued to have attacks of acute cholecystitis which necessitated two subsequent cholecystostomies and died following the last operation. Cholecystostomy solved the immediate problem in these patients, but their deaths must be ascribed to the incompleteness of an operation which is not a curative procedure. Secondary cholecystectomy combined with choledochostomy where indicated would probably have prevented death in all. Physicians must be emphatic in urging subsequent removal of the gallbladder following cholecystostomy.

SUMMARY AND CONCLUSIONS

1. Cholecystostomy still has a place in the surgical treatment of acute cholecystitis when the junction of the cystic and common ducts cannot be adequately visualized or when the general condition of the patient is desperate.

2. Cholecystostomy must never be considered a complete, definitive, curative operation. A long-term follow-up study of eighty-four cholecystostomy patients showed unsatisfactory results in one-third. Five patients died because cholecystostomy was not followed by a more complete operation.

3. Unless clearly contraindicated by the general condition of the patient, every cholecystostomy should be followed by a secondary cholecystectomy irrespective of the length of time the patient remains symptom free.

FURTHER STUDIES IN ARTICULAR REPLACEMENT*

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ABOUT twelve years ago, in discussing some of the unsolved problems in fracture surgery with Clay Ray Murray, we included among these the internal fixation of fractures, the basic phenomena of bone healing, myositis ossificans, degenerative change following anatomical neck fractures of the humerus and subcapital fractures of the femur.

Some progress has been made since then in the partial solution of some of the problems. Recently, however, Paul C. Colonna[1] has again called attention to the present status of femoral neck fractures. Despite the improvement in modern technique of fixation, he states that "From the best statistics available today one may anticipate the development of late aseptic necrosis in approximately one-third of the cases united by solid bony union!" With degenerative arthritis as another complication, femoral neck fractures still remain what Kellogg Speed has called "The Unsolved Fracture."

About ten years ago the problem of articular replacement was attacked experimentally. As a result of observations on the effect of stress concentration and dispersion with internal fixation of fractures, the mechanical approach was avoided and a fresh idea was tried and eventually adopted. The reasoning was simple. If fixation of replacement elements to bone causes stress concentration and thus bone and other tissue death, diffuse the fixation of the stress-bearing elements. Allow the replacement elements to reach an equilibrium with the host tissue. The surgical attempt to carry out this idea was made in dogs and reported in the August 1946 Volume of "The Annals of Surgery" dedicated to Allen O. Whipple.[2] One animal which had a follow-up of about five and a half years was included in the report. It is sufficient to say that except for certain technical difficulties, the dynamic relation of the donor element and the host tissue became stable and the idea of articular replacement without fastening at any specific points was feasible.

The purpose of this paper is to lay in your hand evidence that a new departure has been made in an attempt to answer the question implicit in "the unsolved fracture." Certainly the question of restitution of blood supply has been answered since by substitution regional blood supply is not needed. How far degenerative or hypertrophic arthritis of the acetabulum will complicate the picture, will depend on a long follow-up.

It so happens that parallel problems of restitution occur when the basic supportive substance of bone, which we call bone matrix, is destroyed by tumor, cystic disease or other processes or when the joint is encroached upon by various diseases.

In 1947 some bone matrix replacement studies[3] were reported. At this time we wish to report work done so far in the replacement of the femoral head and neck in six hips and one shoulder.

CASE REPORTS

CASE 1. No. 851272. A forty year old business woman was admitted to Presbyterian Hospital on December 11, 1946, for biopsy. She had had pain for about two years which had taken her to various doctors. The pain ultimately localized so that x-rays of the right hip taken on December 4th revealed a destructive

* From the Department of Orthopedic Surgery, Fracture Division, College of Physicians and Surgeons, Columbia University, New York, N. Y. This work was made possible by a grant through The Office of Naval Research, United States Navy Department.

expansile lesion of the femoral head, neck and upper shaft. On December 12th a biopsy was performed on which a tissue diagnosis of chondrosarcoma of a well differentiated grade was made. Disarticulation was declined. The pain and disability continued and on January 30, 1947, following consultation, an arthrotomy was performed. A previously prepared element combining an acrylic polymer head, neck and shaft portion with three perforated intramedullary pins was used to replace the excised portion of the head, neck and shaft. She was placed in a plaster spica which was removed on April 13th. She began exercises with limited weight-bearing.

She continued to improve until at four months she was capable of full weight-bearing using a cane on the unoperated side to prevent faulty weight-bearing because of abduction weakness.

On April 1, 1948, approximately a year after she had started walking, she was re-admitted to the hospital because of a palpable mass in the anterolateral aspect of the mid-portion of the operative wound. The motion of the hip joint at this time was: limited flexion to 145 degrees, internal rotation 75 degrees, external rotation 90 degrees, abduction 45 degrees and adduction 25 degrees.

Re-exploration through the previous incision was done and a large tumor mass enveloping about one-third of the lucite portion of the replacement element was excised. Her wound healed per primum and sixteen days after operation the patient was up walking on crutches.

At operation the replacement element was quite mobile. The postoperative x-rays showed two of the fenestrated pins at their junction with the acrylic part to have fractured. Examination of the recurrent tumor revealed it to be again a well differentiated chondrosarcoma of limited malignancy.

One month after removal of the recurrence she was sent to a convalescent home able to crutch without weight bearing, and having no pain. (Fig. 1)

Case II. No. 881007. A fifty year old farmer was admitted to the hospital on November 17, 1947, for articular replacement. He gave a history of gradual onset of stiffening and pain in the right hip which had been getting progressively worse for about ten years.

Stereoscopic x-rays showed essentially complete destruction of the joint with obliteration of the joint space. The acetabular margin showed marked irregularity with cyst-like areas. The head of the femur was flattened and had an irregular density. The appearance was consistent with a severe degenerative osteoarthritis or a so-called malum coxae senilis. Other laboratory data were essentially negative. The right lower extremity showed a 3 cm. shortening with movement considerably limited. The flexion arc was from 90 to 165 degrees. Internal rotation was nil; external rotation was 30 degrees; abduction 15 degrees and adduction 5 degrees.

He was operated upon November 20th and the femoral head and neck were replaced with an articular element. He was placed in a plaster spica with the right leg slightly externally rotated with 25 degrees abduction and about 45 degrees flexion. He had a stormy course with several embolic showers requiring anticoagulant therapy for twenty-nine days. His plaster was removed thirty-four days after operation. Five days after plaster removal the passive movement in his hips was: flexion 125 degrees, external rotation 70 degrees, internal rotation 10 degrees, abduction 25 degrees and adduction 15 degrees. At this time he was able to bear full weight for a few steps without crutches but was not encouraged to do so. (Fig. 2)

At four months the patient was able to drive his car and walk although he still preferred crutch support because of some persistent pain in the region of the greater trochanter. At six months he was able to operate a planter and do moderate farm work. He gets about the house on a cane and elsewhere uses one crutch.

Case III. No. 895878. A twenty-five year old army navigator lieutenant was admitted to the hospital on January 7, 1948. He gave a long history of difficulty involving both hips and spine. His earliest memorable difficulty was in July, 1942, at which time he had pain in the adductor muscles attributed to strain during a cross country run. He flew the Atlantic as a navigator until May, 1944. The patient was diagnosed as a case of Marie Strümpell's disease on June 1, 1944, and retired from active duty on December 11, 1944. His stiffness and pain continued to progress until February, 1946, from which time he was confined to bed.

At the time of admission examination revealed a pale young man confined to bed because of fusion of both hips, lumbar and dorsal spine. The cervical spine was fused with the

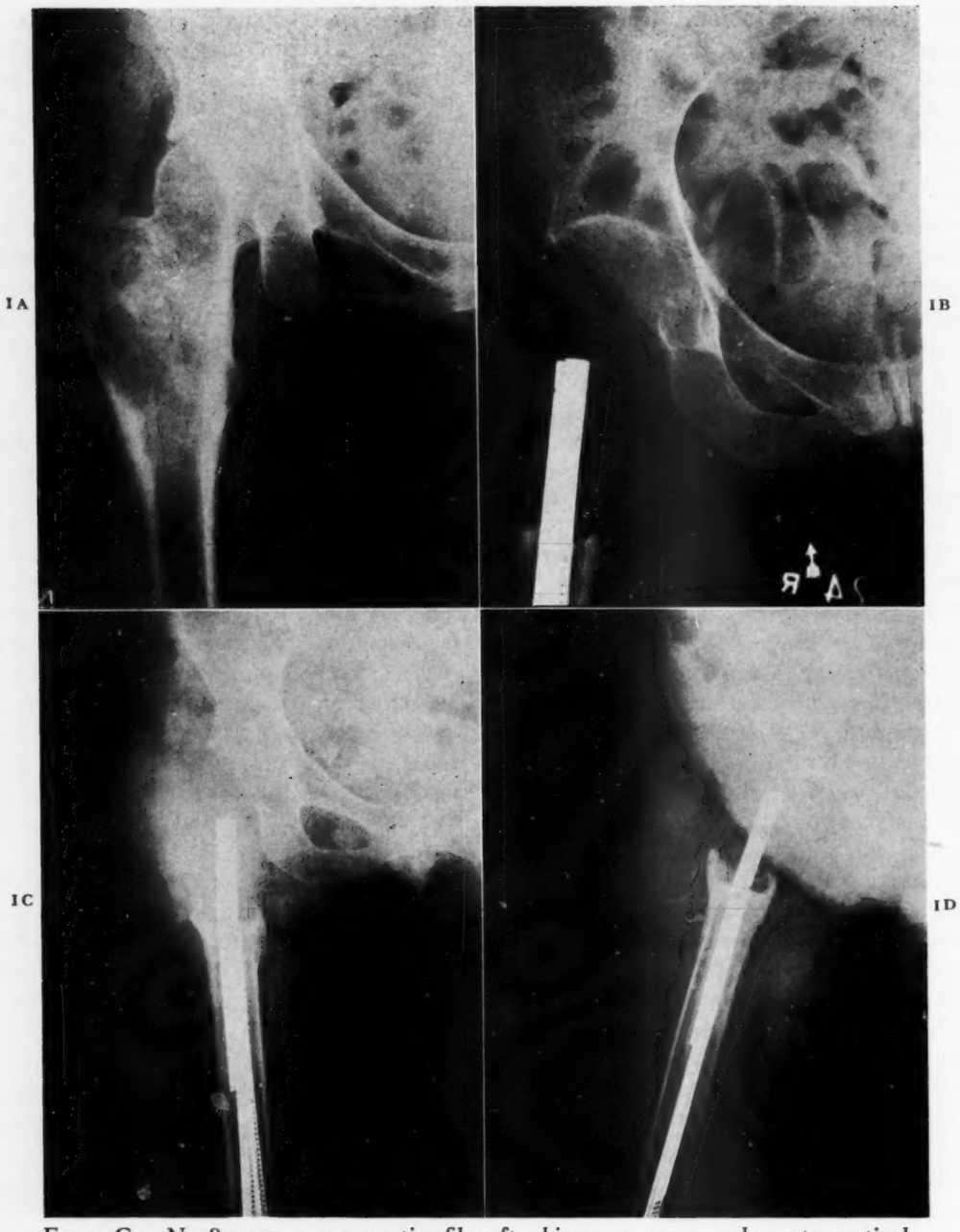
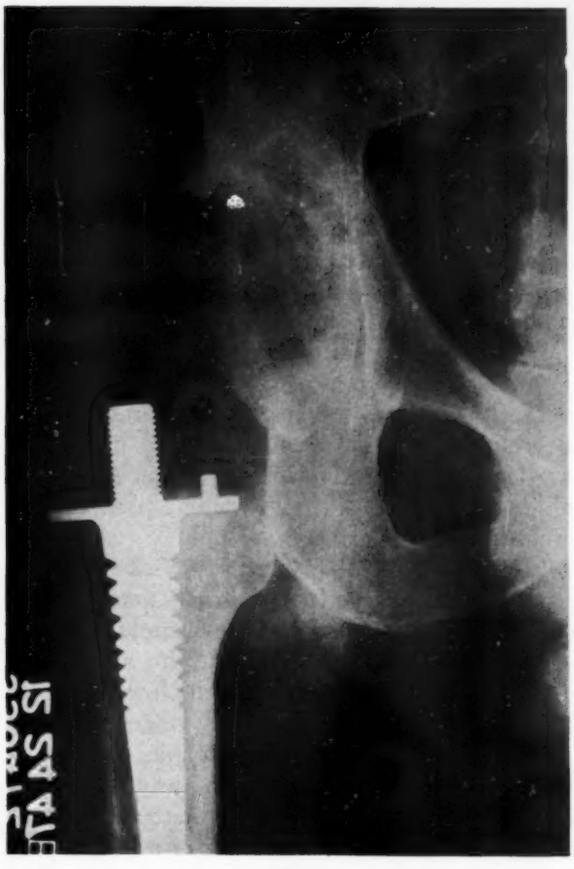


FIG. 1. Case No. 851272. A, preoperative film after biopsy; B, seven weeks postoperatively, patient bearing weight on one crutch; C, twenty-eight weeks postoperatively, patient bearing weight on one cane; D, one year and two months postoperatively, six weeks after excision of local recurrence.

head fixed in about 30 degree flexion. The temporomandibular joints retained about a 70 degree range of motion. The excursion of the thoracic cage was markedly limited and his vital capacity was 3.8 L. (original height 6 feet 1 inches, plus; usual weight 190 pounds; loss of 22 pounds). His organ systems were essentially negative except that at one test he had a congo red retention of 80 per cent and the blood volume was about 62 per cent of normal; blood pressure was 145/90. Thighs and legs were tense, shiny and atrophic with some pitting edema. Knee motion was 150 to 120 degrees bilaterally and the ankle range was 120 to 100 degrees. Sedimentation rate was 58 mm., bleeding time four and one-half minutes; clotting time six minutes. He was thoroughly prepared and on January 13, 1948, a bilateral venous

2A

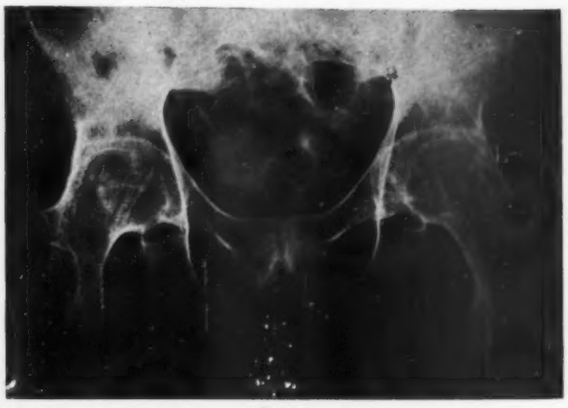


2B

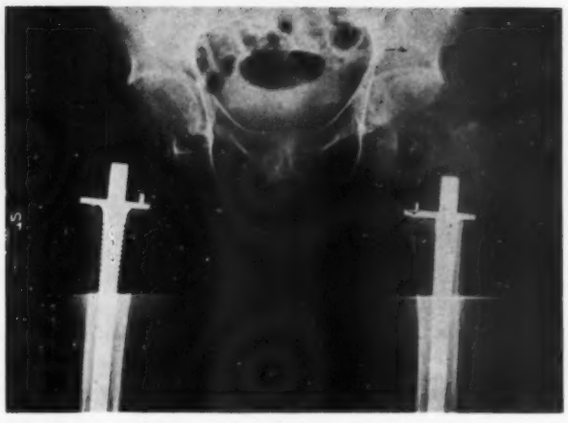
FIG. 2. Case No. 881007. A, preoperative film in severe degenerative malum coxae senilis; B, postoperative film.

ligation was done to reduce the likelihood of pulmonary accident.

On January 15th the right hip was operated



3A

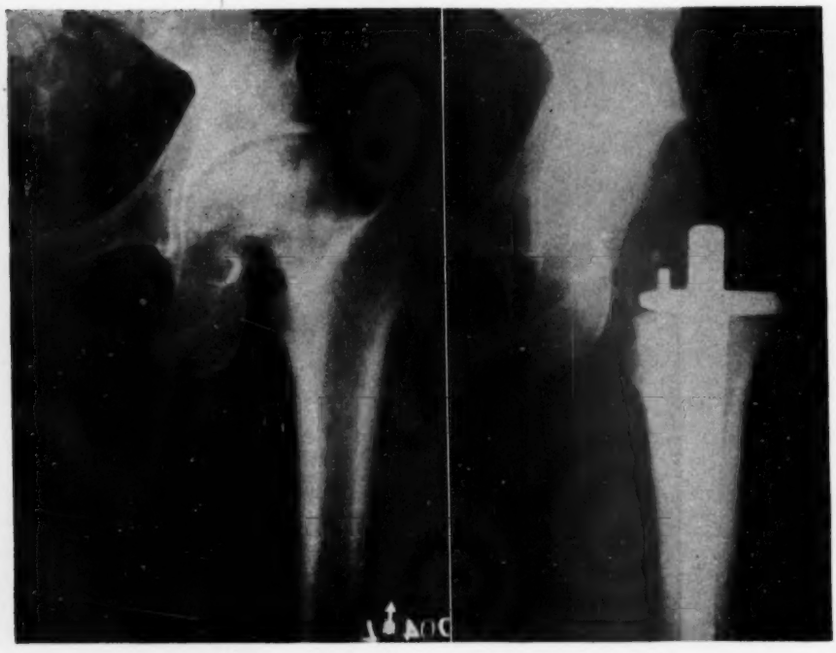


3B

FIG. 3. Case No. 895878. A, preoperative film showing bilateral fusion; B, composite postoperative film, right hip five months and left hip two months after articular replacement.

upon and the fused joint including all the diseased periarticular tissue was excised, and an articular replacement used to substitute for the excised femur. There was moderate vascularity and 2,500 cc. of whole blood was used. He tolerated the procedure fairly well and three days postoperatively was able to rotate his leg slightly. Rolled on his unoperated side, he had 10 degrees plus passive flexion and abduction of the hip joint without pain.

His postoperative improvement was not smooth but steady. On his eighteenth postoperative day he stood and began hesitant but real pendulum exercises, rediscovering muscles making adduction possible; also internal and external rotation and flexion. Except for some preliminary coaching he had not used these muscles in over two years. He showed steady improvement and at nine weeks was able to be up for an hour walking on crutches and having 30 degrees active motion in all planes. At this time he was capable of bearing full weight on



4A 4B

FIG. 4. Case No. 872470. A, preoperative film; B, postoperative film about six weeks after articular replacement.

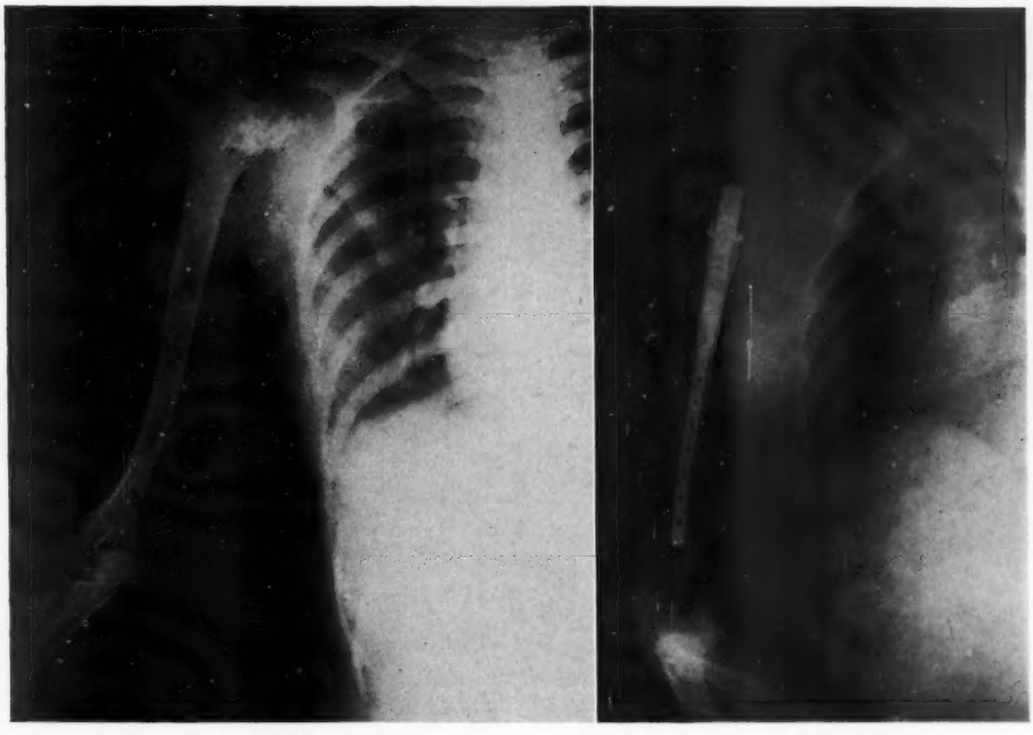
the operated joint but was not encouraged to do so.

On April 12, 1948, just three months after the first operation, the left hip was done and an articular replacement used. On the seventh postoperative day he was gatched up in bed flexing his hips for the first time in well over two years. He was begun on muscle exercises. Twenty days after the second operation he was up for a short time on crutches. He was up and about progressively and five weeks after operation was able to spend about three hours out of bed, walking with crutches, sitting and exercising in the Hubbard tank. (Fig. 3)

CASE IV. No. 872470. A thirty-two year old ex-service mechanic who had had pain in his left hip for about twelve years was admitted to the hospital on March 9, 1948. His work-up was essentially negative and he was operated on March 15th with the application of an articular element. Postoperatively he was placed in Wilke boots in moderate internal rotation because the lateral rim of the acetabulum had been flattened and he tended to dislocate at the time of operation. When his wound was healed, he was placed in a plaster spica until five weeks postoperatively when he was started on exercises.

He was discharged forty-eight days following operation managing on crutches well but not bearing weight. At eight weeks postoperatively he was able to bear full weight but not advised to do so. At that time the active motion of his operated joint was: flexion 150 degrees, extension 180 degrees, internal rotation 20 degrees, external rotation 15 degrees, abduction 20 degrees and adduction 15 degrees. Passively, his hip flexion was to 90 degrees, extension to 190 degrees, external rotation 30 degrees, internal rotation 30 degrees, abduction 35 degrees and adduction 20 degrees. He was able to sit up in a chair without pain and to cross his legs. (Fig. 4)

CASE V. No. 904878. A twenty-one year old patient who worked in delicate machine assembly had shoulder stiffness and pain for about eleven years. At one time she was offered a "bone-scraping" operation which she refused. She went to another hospital where she was treated each Sunday for a whole year with x-ray, dosage unknown. She was seen by several other private doctors and ultimately went to a hospital where a biopsy was done and a diagnosis of chondroblastoma was made. She had the alternative of shortening and fusion or an articular replacement with relatively normal length. Her history and physical examination were essentially negative except for an old torticollis which had been cared for. The right shoulder and arm was considerably atrophic;



5A 5B

FIG. 5. Case No. 904878. A, preoperative film of chondroblastoma (sarcomatous change at time of excision; B, postoperative film six weeks after articular replacement.

and although the elbow, hand and rotation movement of the forearm were essentially normal, the motions at the shoulder joint were about 10 per cent of normal and most of it was interscapulothoracic.

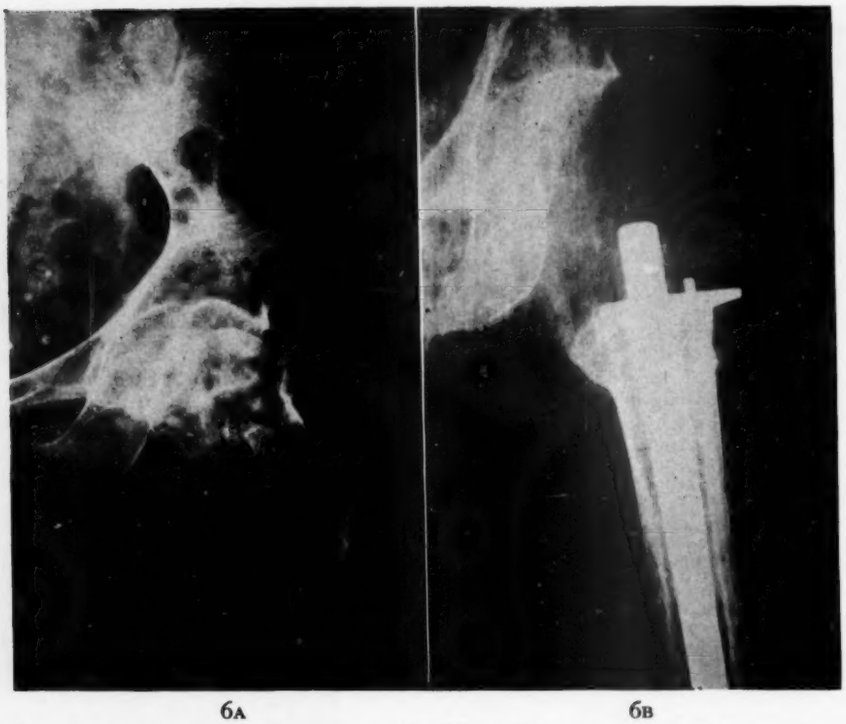
She was admitted to this hospital on April 5, 1948, for articular replacement. Previous to operation her laboratory findings were essentially normal. On April 8th the combined transacromial and Bankart type of approach was used for the section of the shoulder. The upper portion of the humerus was excised to about the level of the mid-portion of the insertion of the pectoralis major.

At operation the deltopectoral interval was completely obliterated with scar tissue and the substance of the deltoid obliterated and scar tissue had encroached everywhere except on a small section posteriorly. The shoulder cuff had disintegrated under deep therapy allowing the cuff muscles to retract. The only muscle tendon that could be identified was the teres major. A dense cord of fibrous tissue encroached upon the neurovascular bundle. The patient tolerated the procedure fairly well with the help of 1,000 cc. of whole blood.

In one week she was capable of adduction, abduction and circumduction. In a month she could reach above the ear and to the midline posteriorly on the sacrum. The pain on movement was quite insignificant but her glenohumeral abduction remained only about ten per cent.

At seven weeks after operation she was doing her own ironing, ate her meals with the operated arm and could rotate her arm internally enough to button her dress posteriorly midline, lumbar 2. She could get both hands on the top of her head and brushed her hair and teeth with the operated arm. She still had some persistent bad weather ache but was improving and wanted to go back to work. (Fig. 5)

CASE VI. No. 876050. A sixty-four year old female was admitted to the hospital on February 21, 1948, for reconstruction of the left hip because of injury in April, 1946. At that time she sustained a subcapital fracture of the left femur which was treated at another hospital with Smith-Petersen nail insertion. She was admitted to this hospital on July 6, 1947, about a year and two months after her first operation for removal of the Smith-Petersen pin. She had pain on motion but managed to get about with crutches.



6A 6B

FIG. 6. Case No. 876050. A, preoperative film of hip two and a half years after fracture and pinning, showing aseptic necrosis of head and non-union of the neck of the femur; B, postoperative film six weeks after articular replacement with complete restitution of 2 inches loss of length.

Observation since that time revealed that not only was non-union present but that there was also about a 2 inch shortening and aseptic necrosis of the femoral head.

On February 24, 1948, the left femoral head and neck were excised and an articular replacement inserted. The immediate postoperative course was complicated by an acute condition of the gallbladder and a thrombophlebitis, left. The former was brought under control with penicillin therapy, the latter with anticoagulants.

The patient was up on crutches with pendulum exercises fifteen days postoperatively before the thrombophlebitis intervened forcing her back to bed. She was restored to ambulation one month and three days after operation and from then on her course continued to be uneventful. She was discharged on her thirty-eighth postoperative day. She had regained slightly more than her previous loss of length and was able to lift her leg off the bed for the first time in over two years. The motions at this time were: flexion 115 degrees, abduction 35 degrees, adduction 15 degrees, internal rotation 5 degrees and external rotation 35 degrees.

Two months and eleven days postoperatively the patient was walking rather well with crutches, using a cane in the house. She was able to put on her own shoes and stockings. Her only complaint was gluteal pain in the region of the posterior limit of the incision. (Fig. 6)

OPERATIVE PROCEDURE

The application of the replacement elements is not too difficult. Getting accurate measurements is one of the phases making ease of application possible. Familiarity with the hazards of intramedullary pin fixations and with the variability of the medullary canal facilitates the application of the articular element. The technics of the operator brought to its most basic components consists of the following:

Exposure. Utilize the anterior Smith-Petersen approach. Save, whenever possible, the rectus femoris and its attachment. Adequate detachment from both faces of the innominate bone contributes to ease of dislocation, excision of the femur and revision of the acetabulum.

Excision. Excise the capsule as completely as possible. This removes diseased and scar tissue allowing for greater operative flexibility. Estimate the amount of femur to be excised, allowing for restitution of length where possible. Excise the estimated segment with or without dislocation, depending upon limitation of movement, posterior scarring deformation and other factors. Save only the outer shell of the greater trochanter. Complete the excision of the posterior capsule. Essentially, this denervates the joint, reduces postoperative pain and muscle spasm. In well reconstructed cases active motion is possible on the first postoperative day.

Seating. Open the marrow canal and feel out its peculiarities with an intramedullary pin. Prepare the canal for the seating. Test the length of the open gap to be sure the fit for the head element is not too snug and that reduction is possible after the seating of the intramedullary portion. Seat the element with the patella straight up and the element externally rotated about 25 degrees. Reduce and test for motion, snugness and stability.

Closure. Settle the motor flanges into the trochanteric shell and suture into place pulling the shell anteriorly to snug up the gluteal aponeurosis. Where possible, utilize the reflected lateral portion of the rectus femoris and suture it to the anterior limit of the gluteal aponeurosis to stabilize against lateral slipping. Suture the deep covering of the tensor fascia femoris to the lateral limit of the rectus femoris. Close in layers. Where reconstruction is considered to be unstable, place in plaster. Otherwise, use only a posterior shell with cross bar to prevent rotation.

COMMENT

The acrylic polymer is suitable for the head element. Our own observations and those of Harmon[4] led us to the use of this material. It has characteristics which make it difficult to sterilize. However, when aged and free from catalyst contamination, it is relatively inert in tissue. Whether or not it can stand up against wear for ten years or longer remains to be seen.

It should be borne in mind that although only one case of post-fracture aseptic necrosis of the femoral head is cited in this series, the other hip cases reported were more complex and involved essentially the same process, namely, replacement of the diseased femoral head.

The remarkable freedom from pain and speed of rehabilitation depend upon the virtual denervation of the joint that goes with complete excision of the synovial membrane and capsule. This allows a hip in which the acetabulum has not been deformed and in which a good reconstruction is done to have pendulum exercises at three weeks. When the acetabulum is deformed and reconstruction is not strong, plaster immobilization for five weeks is indicated.

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SURGICAL ANALYSIS OF 124 CASES OF PROVEN ACUTE CHOLECYSTITIS

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THERE is no doubt in the minds of practicing physicians that an acute appendix should be removed immediately upon diagnosis. However, there is a tendency to apply another set of principles when the gallbladder is acutely involved; there exists the eternal hope that surgical intervention can be avoided. Those members of the profession who have been following the statistical studies during the past decade become cognizant of the fact that cholecystectomy is the proper treatment for acute cholecystitis; however, the question of when should the cholecystectomy be done has caused a lively debate.

Delayed surgical intervention often results in gangrene with perforation, leading to localized or generalized peritonitis. If the individual does recover from the acute attack, another is likely to follow and the ultimate result is cholecystectomy under less favorable conditions. Each attack with its toxic effects makes a lasting scar on the heart, kidneys and liver, augmenting the surgical risk. Therefore, the purpose of this survey is to examine the claim that the earlier surgical intervention is done in gallbladder disease the better are the results. We shall also try to determine how much time should be spent stabilizing the patient prior to operation. An endeavor shall be made to establish criteria for judging the readiness of an individual to undergo surgery when there is failure of immediate stabilization.

The cases in this study were taken from the records of Charity Hospital in New Orleans from the year 1937 to 1946. These records were taken from 320 charts signed: acute cholecystitis. In reviewing the records it often seemed that the diagnosis of acute cholecystitis was questionable for in several instances the individual had attacks of gallbladder colic which subsided in a few hours and which were relieved by medication. These attacks were unaccompanied by a temperature change, elevation of the leukocyte count, a palpable mass, prolonged pain or tenderness over the gallbladder area. After eliminating those cases in which diagnosis seemed doubtful there remained 209 cases of acute cholecystitis; 124 of these were demonstrated by surgery and one case by autopsy. However, this statistical study deals only with those proven surgically.

Cowley, in a twenty-two-year survey at Henry Ford Hospital, found twenty-five cases, of which twenty-four were proven by surgery and one by autopsy. Clagett stated that acute gallbladder accounted for 20 per cent of all biliary tract disease and Judd and Parker in 1924 noted that thirty-six or 4 per cent of 861 cases of cholecystic diseases were acute cholecystitis.

Of those treated surgically in the Charity Hospital group twenty-seven had been re-admitted to the hospital on one or more occasions. There were ten patients who had no previous attack of cholecystitis nor any history of digestive disturbance. In this group there was one death. There were sixty-seven whose histories bore witness of previous attacks; in this group there were seven deaths.

There were ninety-seven white patients of whom sixty-seven (69 per cent) were females and thirty (31 per cent) were males. Of the negroes twenty-seven (87 per cent) were females and four (13 per cent) were males. The totals were ninety females

(72 per cent) and thirty-four males (28 per cent). The ratio of 3:1 is contrary to the common belief that acute cholecystitis is equally prevalent in both sexes.

The age distribution can be obtained from the following table:

TABLE 1

	Under 20	20–29	30–39	40–49	50–59	60–69	Over 70
Zinninger 81 cases	2	14	17	29	14	11	
Charity Hospital 124 cases	..	..	30	30	26	20	5
Eliason and Stevens 108 cases	23		48		37		
Saint 44 cases	1	0	5	10	18	18	

From Table 1 it is evident that the majority of cases, excluding those from Charity Hospital, were patients between the ages of thirty and fifty years. However, in the Charity Hospital survey the distribution is practically the same in the third, fourth and fifth decades and in the sixth it is relatively high. There were forty-three surgeons at Charity Hospital who participated in the procedures involved in these cases; only ten operated on five or more patients; three of these surgeons had no deaths occur and their operations took place within the first twelve hours after onset of symptoms.

It is interesting to notice the relationship between duration of present illness prior to hospitalization and the number of days spent in the hospital, also the relationship between duration of the present illness prior to the operation and mortality. In those patients whose present illness appeared only one to three days preoperatively there were seven deaths (12 per cent); in those in whom it appeared in four to seven days there were five deaths (17 per cent); in those in whom the illness appeared in two weeks there were three deaths (8 per cent), and in those in whom it appeared in three weeks, there was 1 death (21 per cent).

Among the fifty-four patients whose present illness was from one to three days duration thirty-one were hospitalized two weeks, thirteen were hospitalized three weeks and ten were hospitalized four weeks.

Sixty patients were operated upon during the first three days of their illness, of whom seven died; twenty-eight were operated upon during the interval between the fourth and the seventh day, of whom five died. Of those operated upon between the first and second weeks three died. Three were operated upon during the third week. During the first postoperative week twelve died; during the second postoperative week three died and one died in each of the three following weeks.

In fourteen cases acute appendicitis was thought to be the cause of the acute condition of the abdomen. All fourteen patients had acute cholecystitis and three had an associated acute appendicitis. These figures are not in keeping with Mentzer's report which concluded that acute gallbladder disease was associated with acute appendicitis in 60 per cent of his cases.

In making a survey of this nature one is often tempted to venture a theory of his own. While gathering these statistics, the question as to how acute cholecystitis developed was always in mind. In attempting to answer that question it seems that it is necessary for the cystic duct to be obstructed either by stones or an inflammatory process; second, bile must be in the gallbladder to produce irritation; third, the secretions of the mucous membrane must continue or increase so as to produce tension; fourth, the tension thus produced must cause obstruction to the gallbladder blood supply causing tissue damage; finally, organisms must find their way into the necrosed tissue or multiply in the lumen to produce empyema. This seems to be the sequence of events in the development of gallbladder disease.

It is extremely difficult to establish a diagnosis in acute gallbladder disease due to the lack of past history and because the symptoms and physical findings are

misleading and do not always seem referrable to the gallbladder. The impulse initiating in the gallbladder may be referred to other organs.

In 60 per cent of the patients studied nausea was followed immediately by vomiting or as late as eighteen to twenty-four hours after the original onset. These patients were not able to retain any food; indeed, vomiting occurred without food intake.

Dyspnea due to diaphragmatic irritation was found to occur in only four patients whereas Bodenstat reported this complication in 50 per cent of his patients. Jaundice occurred in twenty-nine patients but was complained of by fifteen; of this group stones were found in twenty-four of the patients who underwent surgical intervention. Death occurred in four individuals who had jaundice, two had and two did not have stones.

Obesity is said to be a frequent finding in gallbladder disease; Mentzer reported that seventy-seven of his patients weighed over 210 pounds. However, in the present series only six of the patients were described in the histories as markedly obese.

The chief complaint in 84 per cent of the patients was pain over the gallbladder area. This pain was penetrating in type and in 58 per cent of the cases it travelled to the area beneath the right inferior scapular angle. These patients became progressively worse and could not obtain relief from ¼ gr. morphine sulfate. It was necessary to administer ½ to ¾ gr. to give the desired relief.

Indigestion was a complaint in 75 per cent of the cases. These individuals gave present and paid histories of food intolerance, either qualitative or quantitative. Their difficulty was mostly expressed as indigestion following ingestion of greasy foods.

Diarrhea occurred in only 3 per cent of the patients and only one gave a past history of Amoeba histolytica.

Temperature elevation on admission to the hospital was as follows (Table II):

TABLE II

Degrees of Fever	No. Patients
0	26
1	37
2	25
3	29
4	8
5	6

The total white count was less than 9,000 in twenty-one cases among which were four cases of gangrene of the gallbladder. The highest count was 32,000; this was found in a patient who had an associated pneumonitis.

There were forty-three patients who had had previous x-ray and in whom stones were found upon operation. The roentgenologist was able to make a proper diagnosis in eighteen cases and unable to do so in twenty-five cases. There were twenty flat plates and twenty-three that had visualization of the gallbladder. The dye failed to visualize the gallbladder in twenty-one cases; in two of the cases in which the gallbladder was visualized the diagnosis of stones was made but operation proved that there were no stones.

There were nineteen patients who presented a definite mass. This mass was palpable as early as three hours after onset and in five instances the mass arose after the patient had been admitted to the hospital.

Saint believed that a palpable gallbladder was a certain sign that immediate operation was advisable. The present series verifies this belief since in all cases in which a palpable mass was found on admission to the hospital there was gangrene of the gallbladder; in those cases in which the mass arose after admission there was no gangrene but distention was found in two instances, in one instance due to increased mucous content and in the other due to purulent secretions.

It is important to be able to distinguish acute cholecystitis from biliary colic. This differentiation is often difficult since both may be accompanied by nausea, vomiting and a mild degree of temperature elevation. Pain in acute cholecystitis, however, is

usually more difficult to handle than in biliary colic. In fact, any pain in the gallbladder area that lasts over two hours which is not relieved by morphine sulfate and atropine suggests acute gallbladder disease. Acute cholecystitis is a progressive illness. After administration of narcotics a soreness remains over the gallbladder area. When there is a high white blood cell count, elevation of temperature and a palpable mass the diagnosis is obvious.

Acute cholecystitis often may be confused with coronary thrombosis, but gallbladder pain is more severe and lance-like whereas coronary pain may be described as pressing and choking. Pain in coronary disease is usually referred to the left arm, but in gallbladder disease the pain is referred to the area beneath the right scapula. Gallbladder pain is long-lasting while coronary pain is not. Electro-cardiograms are helpful at times in differentiating the two diseases. From the total study of 320 cases there were no instances in which a patient with coronary disease was operated upon for acute gallbladder disease.

Perforated and perforating peptic ulcers are also difficult to distinguish from acute cholecystitis. The complication of an ulcer rupturing and becoming fixed to the gallbladder occurred in one patient in this series. The gallbladder was edematous and showed signs of acute inflammation only because of the perforating ulcer in the duodenum. This individual was operated upon with a preoperative diagnosis of acute gallbladder disease. However, two patients who were diagnosed preoperatively as having ruptured peptic ulcer were diagnosed postoperatively as having acute cholecystitis.

There were several complications of acute cholecystitis which were met in the course of this study. Acute gallbladder with rising intraluminal tension results in either a spontaneous overcoming of the obstruction or rupture through the gangrenous area, commonly the fundus. The blood supply is likely to be cut off due to tissue necrosis and pressure exerted on the vessels from both intracellular edema and increased luminal pressure. If perforation occurs, it may be into the viscera or the free peritoneal cavity or it may form a localized abscess. Perforation occurred in two patients in this series, both negro females; one, thirty-five years of age, developed a subdiaphragmatic abscess and died; the other, forty-two years old, had a localized abscess and survived after a stormy course.

There were five diabetics with acute gallbladder disease, two of whom died; they had been in good condition before surgery but exploration of the common duct was undertaken. It appears that cholecystostomy would have been preferential in these cases. Typhoid fever was a complicating factor in four patients, one of whom died.

That the correct surgical treatment for acute cholecystitis is cholecystectomy remains unchallenged since this procedure is curative. Cholecystostomy should be considered a palliative procedure pending cholecystectomy as soon as the patient's condition permits. At least six of the eighteen patients in this series who underwent cholecystostomy required cholecystectomy at a subsequent time. Cholecystostomies should not be done when a cholecystectomy is possible for a gallbladder that has a part of its wall fibrosed and thickened by scar tissue cannot ever resume normal function. Cholecystostomies are indicated when technical difficulties arise or when the patient is acutely ill and time becomes an important factor.

Whether preoperative preparation has taken a great number of patients from the dangerously ill group and enabled them to withstand curative surgery remains to be demonstrated. At least the information gleaned from this survey is as follows:

The following division of the patients under study into the number of hours in the hospital prior to operation affords some idea as to the necessity of preoperative preparation and the importance of immediate surgery.

There were fifty patients operated upon between the third and the twelfth hour after admission to the hospital. The group included seventeen males and thirty-three females. There were thirteen (26 per cent) cholecystostomies and thirty-seven (74 per cent) cholecystectomies. The duration of illness prior to admission was 4.5 days. The duration of hospitalization of those who survived the first twenty-four hours was twenty-seven days, excluding one who remained in the hospital sixteen months. In this group there were six deaths, two of which occurred in those having cholecystostomy and four in those having cholecystectomy. Four of the six deaths, however, occurred within three hours after operation. These individuals were deemed extremely ill and the surgeons believed that immediate intervention was necessary. Procrastinating with these acutely ill patients for administration of fluids, vitamins, amino acids, etc., could hardly have been lost time since their chances of surviving were already nil. It is understood, of course, that when an earnest attempt to restore the physical level does not improve the patient's condition surgery must be attempted.

There were twenty-three patients operated upon between the twelfth and seventy-second hour after admission. In this group there was a definite attempt at stabilization. There were five males and eighteen females. Cholecystostomy was done in two (8.6 per cent). The average duration before admission was four days, hospitalization was eighteen days. There were nine deaths (38 per cent) of which two occurred during cholecystostomy. In eleven of these patients the pathologic condition was irreversible and surgery became imperative; cholecystostomy was done in only two patients.

The two foregoing groups lend themselves well to contrast. The number of days ill prior to hospitalization was practically the same; the duration postoperatively was twenty-seven days in the group operated upon within twelve hours and eighteen days in the second group. The mortality rate was 12 per cent in the first group and 30 per cent in the second. The number of cholecystostomies was 26 per cent in the first and 8.6 per cent in the second. Thus, it seems that the delay in surgery in an attempt to stabilize the individual was erroneous or the choice of procedure was erroneous. As it was shown an attempt to improve the debilitation in eleven cases proved unsuccessful. This seems to indicate that immediate surgery is the best choice of treatment although it may be palliative. The postoperative status was considered poor in six of the first group (12 per cent) and in ten of the second group (43 per cent). In those operated upon after seventy-two hours the postoperative status was poor in five (15 per cent). In those patients in whom cholecystostomy was done the preoperative condition was considered poor in ten; in three of the patients cholecystectomy was technically impossible.

There were thirty-three patients operated upon later than seventy-two hours after admission. There were nine males and twenty-four females. These individuals were ill (on the average) nine days before admission. Three had cholecystostomy performed and twenty-four underwent cholecystectomy. There were three deaths (9 per cent). The cholecystostomies were done because of the mechanical and technical difficulties encountered. The duration of hospitalization in these patients was thirty-eight days. These patients were observed and treated on an average of eight days before surgery was contemplated. Two of the three deaths occurred in patients undergoing cholecystostomy. It seems that a great deal of time elapsed in the attempt to stabilize the patients while they were growing progressively worse.

The technical difficulties that arose in those cases which occurred seventy-two hours or more after hospital admission separated that group from the previous ones. The edematous tissue which lent

well toward finding clearage planes and helped control bleeding was no longer found in the latter group for the tissues had become matted together by fibrosis. The bleeding became more difficult to control.

There were twenty-one cholecystostomies in this series, five of whom died (23 per cent). This high mortality rate is out of proportion to the figures given by Sanders whose surgical mortality rate of 3.4 per cent in acute cholecystitis rose to 10 per cent in choledochotomy. Of the twenty-one operated upon in this group seven had a stormy convalescence; ten of the twenty-one had no stones in the duct. Death was due to pneumonia in two cases and to subdiaphragmatic abscess in one. The hospitalization was increased eighteen days on the general average. The five who died had stones in the common duct with associated jaundice. Mayo pointed out that when choledochotomies were done in patients with jaundice the mortality rate rose to 58 per cent. With a serious rise in the mortality rate, the surgeon should not open the common duct except if there is definite evidence of: (1) palpation of stones in the duct; (2) jaundice either at the time of surgery or in the past history; (3) dilation of the duct with a small gallbladder and thick bile.

CONCLUSION

It seems from this study that early palliative surgery yielded the lowest mortality rate. It was 12 per cent in those operated upon immediately after hospital admission and it rose to 30 per cent in those in whom surgery was delayed. Individuals that fail to respond to preoperative preparation within a few hours should undergo immediate surgery. The surgeons who operated upon their patients immediately had the lowest mortality rate. Those individuals whose illness prior to hospitalization was short but followed by a rapid crescendo had a higher mortality rate than those who followed a slower course. It appears that these individuals were better able to cope with their illness.

There must be some unknown factor to determine the type of pathologic condition in these acutely ill patients. It appears that for a great number of them immediate surgery is the choice of treatment; yet for another group of these individuals, procrastination with an attempt to restore the physiologic condition would enhance operative risk.

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PHEOCHROMOCYTOMA*

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PHEOCHROMOCYTOMA is a rare, benign tumor of the adrenal medulla. It has been reported with increasing frequency during the past ten years. Frankel in 1886 reported an autopsy on an eighteen year old girl who had bilateral adrenal tumors associated with cardiac enlargement. Von Neusser in 1897 described this tumor in connection with hypertension. In 1922 Labbe, Tinel and Daumer first described the clinical syndrome caused by these growths. The first to make a clinical diagnosis and advise surgical removal of this tumor was Vaquez, Donzelot and Geraudel in 1926. Their patient refused surgery and autopsy findings substantiated their diagnosis. In 1927 Charles Mayo was the first to remove successfully an adrenal medullary tumor but at the time he did not appreciate the nature of the tumor. Pincoffs and Shipley[22] reported a case in 1929 in which they were the first to make a correct preoperative diagnosis and to remove the tumor successfully.

That these tumors are exceedingly rare is shown by the figures of Brunschwig and Humphreys[4] who collected 109 cases up to 1939 of which but eighteen came to surgery, the remainder being discovered at autopsy. Kirschbaum and Balkin,[14] at Cook County Hospital, reported three cases in 14,437 consecutive autopsies. Clagett[16] reported that up until 1944 only thirty-one tumors of the 120 cases reported had been surgically removed.

ANATOMY

The suprarenal gland is composed of a yellowish cortical tissue and brownish medullary tissue which are fused together. The cortical tissue is derived from the lining of the celomic cavity (mesoderm) while the medullary portion comes from the neuroectoderm. This primitive neuroectoderm gives rise to two varieties of sympathetic nerve cells: the neuroblast and the pheochromoblast.[16]

The neuroblasts play the chief role in the formation of neuroblastomas and sympathicoblastomas. The neuroblasts also are the precursors of the sympathetic ganglion cells which are involved in tumors known as ganglioneuromas. These tumors give off no endocrine secretion.

The pheochromoblast is the important cell in the pheochromoblastoma which is malignant and rare.[18] These cells during their development acquire cystoplasmic granules possessing an affinity for chromic salts. They are often referred to as chromaffin cells and occur in the suprarenal medulla, carotid body and organ of Zuckerkandl.[15] Tumors of this type produce endocrine symptoms. The terms chromaffinoma and pheochromocytoma are used to describe suprarenal tumors of this type. They produce symptoms of hyperadrenalism. The term paraganglioma is reserved for extra-adrenal chromaffinomas such as carotid body tumors and tumors of the organ of Zuckerkandl. They do not produce symptoms of hyperadrenalism.

Phenochromocytomas occur equally in both sexes. Nearly all age groups are represented in the reporting of these tumors, the youngest being fourteen years of age and the oldest seventy-one.[3] Tumors in the older age group have been found at autopsy while in the younger group the diagnosis has been made clinically. The tumors occur more often on the right side[19] than on the left. Pheochromocytomas are usu-

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ally confined to one side although bilateral cases have been reported. They are said to be morphologically benign and physiologically malignant tumors.[1] However, eight cases of pheochromocytoma have been reported in the literature[20] as malignant. They vary from the size of a pea to the size of a grapefruit. Weight variations have been from a few Gm. to 2,000 Gm. The tumor is usually encapsulated and incorporated in the suprarenal gland although some have been detached from the suprarenal and lie some distance from it.[25] Tumors on the right side are in close relation to and often adherent to the vena cava.

These tumors secrete a pressor substance into the circulation which is thought to be adrenalin. Beer, King and Prinzmetal[2] have actually demonstrated this adrenalin-like substance in these tumors by perfusing a denervated rabbit's ear with blood plasma removed from a patient suffering from symptoms attributable to a pheochromocytoma. Normally adrenalin is found in the blood in the order of 1: 100,000,000.[1] The normal adrenals contain 4.22 mg. of epinephrine. Kalk[1] has found 375 mg. to 500 mg. of epinephrine in a tumor of this type. The clinical syndrome which is produced by the outpouring of this epinephrine-like substance is often called the adrenal-sympathetic or adrenal-medullary syndrome.

This syndrome is characterized by attacks of paroxysmal hypertension. During these attacks, which are due to the outpouring of adrenalin into the circulation, the patients have symptoms of violent headache, often of the unilateral type, palpitation and tachycardia, flushing, cyanosis, circumoral pallor, sweating, weakness, blanching of the terminal digits,[13] nausea, vomiting and syncope. Hyperglycemia and glycosuria are often present. During an attack the blood pressure may reach levels of 300 mm. of mercury systolic and 150 mm. of mercury diastolic. The clinical picture is not unlike that of shock,[6] these symptoms being those of adrenalin shock.

The interval between attacks becomes progressively shorter. They vary from an occasional attack to attacks several times during an hour. Attacks last from a few minutes to several hours. Changes in posture, pregnancy or any pressure on the tumor often initiate an attack. Many of the attacks, particularly in elderly people, end fatally. As a sequelae of frequent and prolonged attacks the patient often has resulting cardiovascular renal changes which are permanent.[11]

DIAGNOSIS

The diagnosis of pheochromocytoma is often difficult. Symptoms of hypermetabolism simulating those of hyperthyroidism or diabetes mellitus[8,9] are often confusing. Diabetes mellitus has been found in 7.5 per cent of the cases reported. Coronary occlusion, histamic cephalgia, migraine and anxiety states are many times considered in the differential diagnosis. Once the diagnosis of pheochromocytoma is entertained, intravenous and retrograde pyelograms may be of aid in determining the size and site of the tumor. Perirenal insufflation of air may aid in outlining the tumor in the roentgenogram.[2] This procedure is not, however, without danger in these hyperkinetic individuals. Massage over the affected kidney often produces an attack. Kvale and Roth[17,24] have described a test which has proved very successful for inducing an attack—administration of .05 mg. of histamine intravenously. Adrenalin and histamine are antagonists[23] and for this reason, adrenalin is secreted by these tumors following administration of histamine.

Goldenberg, Snyder and Aranow,[10] have developed a technic in which an adrenolytic compound, benzodioxane, is given intravenously. Benzodioxane abolishes adrenalin and is reported to be extremely helpful in making the diagnosis of pheochromocytoma.

Oscillometric readings of the extremities and studies of peripheral blood flow, as well as biologic assay[7,21] of the adrenalin

content in the blood plasma, are all helpful in confirming the diagnosis.

TREATMENT

The treatment of pheochromocytoma, once the diagnosis is made, is surgical. The sooner the tumor can be removed the sooner stress and strain will be alleviated from the cardiovascular renal system. These patients are extremely sensitive to any surgical procedure. It has been found that when a pheochromocytoma is being removed, manipulation of the tumor causes an outpouring of adrenalin with an alarming rise in blood pressure[4] and that when the tumor has been removed, there is a precipitous fall in blood pressure. Sodium nitrite has been used to combat the critical hypertension during surgery and intravenous adrenalin, blood transfusions, saline and cortical extract are used to support the circulation when the tumor has been removed. It is often necessary to carry out these measures for several hours. Inhalation anesthesia has been used most frequently; however, spinal anesthesia has also been used but is considered too dangerous by most surgeons.

Various incisions have been used. Young[26] has described a posterior approach to both adrenal glands. A posterolateral kidney incision with removal of the eleventh and twelfth ribs has provided excellent exposure for removal of these tumors. The transperitoneal route,[5,12] also has been used with much success.

The mortality rate in removal of pheochromocytomas has been appalling, ranging from 25 to 40 per cent in various series reported. To add further to the limited literature on this type of tumor a case is presented which was correctly diagnosed preoperatively.

CASE REPORT

F. B., a male aged forty-three, was first seen at the Interstate Clinic on April 26, 1944, complaining of palpitation and irregularity of the heart, persistent non-productive cough, headache and pallor. He stated that for the previous five months he had at times had a "thumping feeling" over the precordium which would be associated with perspiration and headache. His wife stated that accompanying these attacks he appeared "pale and tired." He had lost 6 pounds during the past few weeks, but this was attributed to hard work while performing his duties as a drayman. His physical examination at that time was essentially normal except that his pulse was timed at 108 per minute. The blood pressure was 112 systolic and 78 diastolic. The urine was normal except for 2 plus albumin and 4 plus sugar. Roentgenograms of the heart and lungs were interpreted as normal. X-rays of the skull showed a normal sella turcica. An electrocardiograph was said to be normal as was his blood Wassermann. During the next two days he was given two basal metabolic tests and these were found to be +24 per cent and +20 per cent, respectively.

On May 1, 1944, he was hospitalized because of his diabetes. His fasting blood sugar was 271 mg. per cent. The glucose tolerance test showed a diabetic curve. He was given insulin and the diabetes was quickly brought under control. It was noted that during his five-day stay in the hospital he became flushed and had headaches. These symptoms were attributed to administration of insulin. He was discharged on a 2,000 calory diet and was taking sixteen units of protamine zinc and twelve units of regular insulin. His weight was 149 pounds.

He then went to Seattle, Washington to work in a shipyard and was not seen until May 14, 1945. At this time he stated that he felt fine and had gained 23 pounds. He had had an occasional severe headache and attacks of weakness and sweating which he also had attributed to insulin. Upon examination, it was found that he had 4 plus sugar and he was again hospitalized May 15, 1945. At this time his blood sugar was found to be 240 mg. per cent. After seven days he was discharged on a diet of 2,400 calories and fifteen protamine zinc and twenty-five units of regular insulin. He returned to the shipyards and worked a year, during which time he had several "insulin reactions." His blood pressure during this two-year period ranged from 110/70 to 130/80.

In June, 1946 he returned to Red Wing and accepted a position as a distributor of news-

papers. He continued to take insulin and began having more frequent insulin reactions. His job necessitated bending over counting newspapers and his wife stated that he often came home after work exhausted, flushed, sweating and complaining of his heart pounding. On two occasions he became unconscious and was relieved by intravenous administration of glucose. On January 21, 1947, his fasting blood sugar was found to be 247 mg. per cent. Physical examination showed his thyroid gland to be slightly enlarged; pulse 120; blood pressure, 140 systolic, 100 diastolic; basal metabolic rate, plus 13. It was also noted that his feet had a bluish discoloration when in dependency.

On February 24, 1947, one of us (R. V. S.), stimulated by reading an article on pheochromocytoma, hospitalized the patient for study. Laboratory findings at that time were as follows: Hemoglobin, 15.8 mg.; red blood count, 4,810,000; leukocytes, 9,350; differential blood count: neutrophiles, 73; small lymphocytes, 6; large lymphocytes, 12; large mononuclears, 5; transitionals, 3; basophiles, 1; blood sugar, 252 mg.; blood urea-nitrogen, 16.5 mg.; creatine, 1.6; cholesterol, 150 mg.; total proteins, 9.2; serum albumin, 6.6 Gm.; globulin, 1.85 mg.; urea clearance, 82.7 per cent; basal metabolic rate, plus 33 per cent. Intravenous pyelograms (Fig. 1) showed the right kidney to be in slight vertical position with the upper pale not made out. The diagnosis was "a possible tumor in the region of the right adrenal." Hourly blood pressure readings showed the systolic pressure to vary from 100 to 250 mm. mercury and the diastolic to vary from 60 to 180 mm. mercury. Massage over the right kidney area brought on a typical attack with extreme hypertension. Intravenous histamine (0.10 mg.) caused the blood pressure to go, in ninety seconds, from normal to 260/180. Amyl nitrite was used to relieve the symptoms. Diagnosis of a pheochromocytoma of the right adrenal was made and the patient was operated upon on March 27, 1947.

Under sodium pentothal and ethylene anesthesia the right kidney area was exposed through a posterior incision described by Young. A tumor the size of an orange was found above the upper pole of the right kidney. The tumor was readily dissected free from the surrounding structures except on the medial side where it was firmly adherent to the vena cava. This dissection was time-consuming and was accomplished with a moderate amount of blood loss. This was anticipated and saline and citrated whole blood were started in two separate veins before surgery. Following removal of the tumor, hemostasis was accomplished and the wound was closed in the usual manner with a Penrose drain. The patient's blood pressure was 144/110 prior to the anesthetic. During manipulation of the tumor the blood pressure reached 210/160. When the tumor was completely separated from all of its attachments, the blood pressure (Fig. 2) dropped to 120/100. Adrenalin was administered intravenously. During the closing of the incision the blood pressure varied from 130/104 to 90/60. When the patient was returned to his room, his blood pressure was 140/90. For the next two and one-half hours almost continuous recordings of the blood pressure varied from "unable to record" to 174/140. In all, 7 cc. of adrenalin were given intravenously; 1,000 cc. of citrated blood and 500 cc. of saline and cortical extract were given. Two and one-half hours after completion of surgery the patient had a rather sudden collapse and died. There was no appreciable bleeding from the incision. An autopsy was refused.

FIG. 1. Intravenous pyelogram showing downward displacement of right kidney.

Pathologic report was as follows: Grossly, the specimen measured 6 by 5 by 5 cm. It

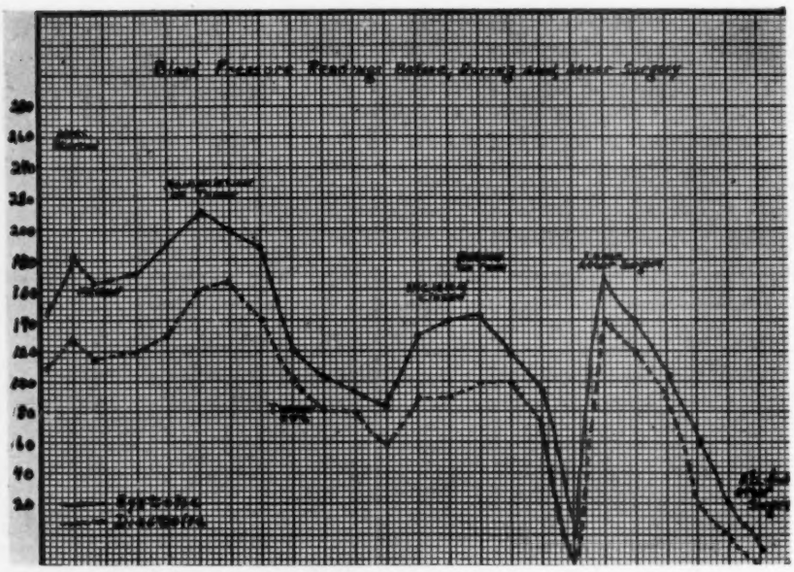

FIG. 2. Blood pressure readings showing extreme changes before, during and after surgery.

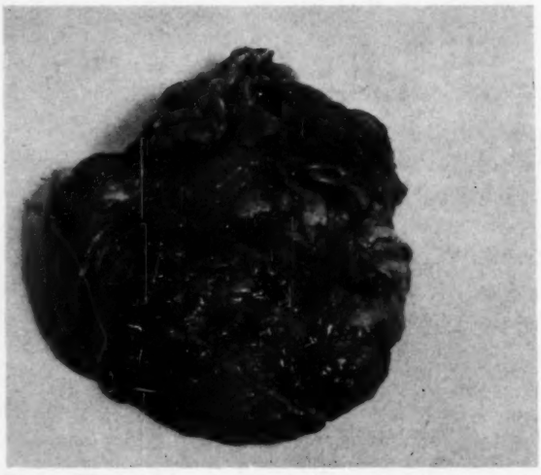

FIG. 3. Tumor after removal. After the blood supply was divided the tumor diminished in size.

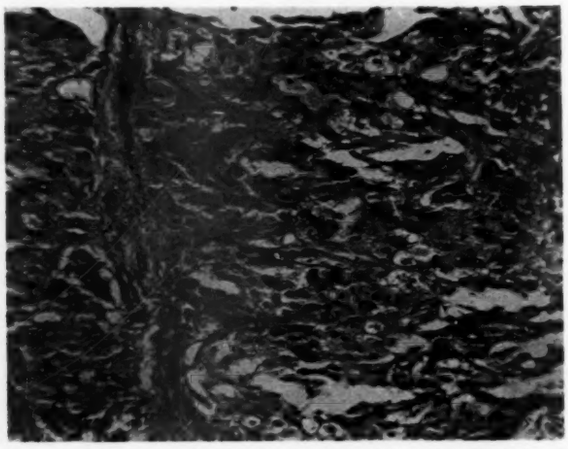

FIG. 4. Microscopically the tumor showed well defined cells with small well stained nuclei.

appeared to be vascular. Attached to the medullary tumor there was a normal-appearing adrenal cortex. There was a rather definite capsule surrounding most of the tumor. (Fig. 3.)

Microscopically, sections of the adrenal tumor showed at one margin portions of the normal adrenal cortex. The tumor was composed of cells which were rather large and irregular in outline. The cell margins were well defined and in places the cells took on a rather pavement arrangement. Cytoplasm in the H and E stain was eosinophilic and the nuclei were fairly small and round. No mitotic figures were seen. The tumor was well defined and in places almost encapsulated. However, the capsule of the tumor showed, in certain areas, infiltrating tumor cells. When the fresh tumor tissue was treated with potassium bichromate, the cells were found to contain brownish granulation. This, together with certain features of the histologic structures of the tumor, definitely fixed it as a tumor of medullary adrenal origin. Diagnosis: Pheochromocytoma. (Fig. 4.)

CONCLUSIONS

1. The literature on pheochromocytoma for the past ten years is reviewed.

2. A case of pheochromocytoma is reported in which a correct preoperative diagnosis was made. The tumor was re-

moved, with a fatal outcome two and one-half hours postoperatively.

3. It is noteworthy that this patient had concomitant diabetes mellitus and symptoms of hyperthyroidism.

4. It is believed that familiarity with the symptoms of this tumor will result in more cases being reported in the future.

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REVIEW OF MECKEL'S DIVERTICULUM

REPORT OF FOUR CASES

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DIVERTICULA may occur in any portion of the esophagogastrointestinal tract. They are of two types, congenital and acquired. The acquired variety is due to mechanical forces of pulsion or traction. Scar tissue adhesions to the wall of the alimentary tract may cause traction diverticula. Internal pressure from scybala or gas within the lumen are the factors principally involved in the etiology of pulsion diverticula. A weakened wall or atrophic musculature predisposes toward the formation of diverticula when distending forces act upon it. Acquired diverticula have no mesentery.

The congenital diverticula are of much more common occurrence than the acquired. They are due to a developmental anomaly. An example of this type of diverticula is the structure described by Meckel 135 years ago which bears the name Meckel's diverticulum. Priority of describing this structure should be credited to Lavater who wrote of it forty years earlier. It is essentially a diverticulum of the ileum, arising from the antimesenteric border of that organ at a variable distance from the cecum. It is a vestige of the ovovitellin duct of the embryo. Normally, this duct has disappeared within the first few weeks of intra-uterine life but, as shown by autopsy statistics, it persists in less than 2 per cent of individuals after birth.

Meckel's diverticulum may present a variety of forms. It may vary from a small, thimble-sized pouch to a tubular structure 10 cm. or more in length. There may or may not be a mesentery present. The sac usually has a blind end and lies free in the abdominal cavity. However, it may be attached at its distal end to any of the surrounding structures. The usual site of attachment is the inner aspect of the umbilicus. In cases of this type there has been a minimum of developmental regression. In a few instances the diverticulum does not have a blind end but forms a fecal fistula which discharges at the umbilicus. It may cause a prolapse of the umbilicus in the newborn or an omphalocele.

Littre's hernia is a name applied to abdominal hernias which contain diverticula. Meckel's diverticulum has been reported in umbilical, inguinal and femoral hernias. The most common site is in umbilical hernia. Left inguinal hernia is probably the next most frequent. The diverticulum may be incarcerated or strangulated.

Microscopically, the lumen is lined with mucosa identical with that of the ileum from which the diverticulum is derived. In a small percentage of cases ectopic gastric mucosa also occurs in the diverticulum. Rare cases have been encountered in which heterotopic rectal, colonic, jejunal and duodenal mucosa also have been seen.[12] In a still rarer group of cases, aberrant pancreatic tissue is found. Meckel's diverticulum is the most distal part of the alimentary tract in which pancreatic tissue has been found.

The pathologic condition resulting from Meckel's diverticulum is quite variable. A search of the literature has revealed reports on the following: (1) Pyogenic inflammations, regional ileitis, ulceration, gangrene, perforation, abscess and peritonitis have occurred. Typical gastric ulcers have developed in some of those patients with aberrant gastric mucosa. Perforations of gastric ulcer in Meckel's

diverticulum are on record. Cases of hemorrhage from gastric ulcer in Meckel's diverticulum are not very rare. This may occur in children. A case of sudden death was reported in 1943 in which a suspicion of poisoning arose but which, at autopsy, opposite a Meckel's diverticulum containing gastric mucosa has been described.[10] (2) Foreign bodies may be present in the diverticulum in much the same way as in the appendix. Several cases of diverticular calculi are on record. They resemble

TABLE I
FINDINGS IN FOUR CASES OF MECKEL'S DIVERTICULUM

	Case I	Case II	Case III	Case IV
Date of operation	Nov. 27, 1946	May 21, 1947	June 24, 1947	Aug. 15, 1947
Color	White	White	White	White
Sex	Male	Male	Male	Female
Age	19	17	19	39
Pain	Two weeks; constant epigastrium	Three days; crampy, generalized	Twelve hours; epigastric and right lower quadrant	None
Nausea and vomiting	Both	Both	Both	None
Tenderness	Slight in right lower quadrant	Generalized	Marked, right lower quadrant	None
Muscle spasm	None	Slight	Positive, right lower quadrant	None
Temperature	97.6°F.	102.0°F.	96.8°F.	99.2°F.
Pulse	74	90	68	94
Respiration	20	22	20	20
Leukocytes	Normal	10,600	16,000	10,100
Preoperative diagnosis	Intestinal obstruction	Intestinal obstruction	Appendicitis, acute	Fibromyoma
X-Ray	Gastrointestinal series showed partial obstruction at midileum; hiatus hernia	Flat plate: obstruction at ileojejunal junction	None	None
Pathologic findings	Long diverticulum attached to umbilicus by fibrous band; micro: ectopic gastric mucosa and pancreatic tissue with chronic inflammation; mesentery	Long diverticulum attached to umbilicus by fibrous band; abscess in distal end; micro: gangrene; ulcerated; edematous; markedly congested; mesentery; torsion of ileum or incomplete volvulus	Large bulbous diverticulum; (may be duplication of ileum); micro: ulcerated and inflammatory intestine; no mesentery	Small diverticulum; no mesentery; unattached; specimen not examined by laboratory
Complication	None	Right lung: pneumonia or infarction; pleural effusion	None	None
Days in hospital	52	55	16	9

proved to be a massive hemorrhage from an ulcer in Meckel's diverticulum. Gastric mucosa in Meckel's diverticulum functions as a "miniature stomach." Ulcers form in the intestinal mucosa due to the acid secretion of the misplaced gastric tissue. An ulcer of the ileum with perforation fecaliths in the vermiform appendix. A case of a fishbone perforating a Meckel's diverticulum was reported in 1942[4] and another in 1943.[3] The writer reported a case of a fishbone perforating the base of the appendix in 1939.[6] Ascaris lumbricoides has been found in Meckel's diverticulum,

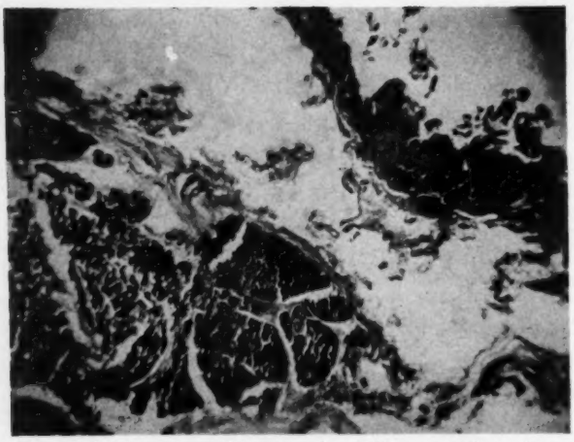

FIG. 1. Low power photograph of tissue sections from Case 1. In the upper right half of the picture the mucosa of the diverticulum can be seen. The lower left half of the photograph represents ectopic pancreatic tissue containing acini, ducts and islets.

causing inflammation and intestinal obstruction. Worms also have been found in the appendix. (3) Tumors of Meckel's diverticulum have been reported as a leiomyoma, polyp, neurinoma, adenoma and adenocarcinoma.

Diagnosis of Meckel's diverticulum is seldom made preoperatively. Conditions caused by Meckel's diverticulum and pathologic conditions due to the presence of a Meckel's diverticulum usually are misdiagnosed.[5] This is due in part to the infrequency with which Meckel's diverticulum is met and the fact that other more common lesions present similar symptoms. Inflammations of Meckel's diverticulum usually are diagnosed as appendicitis. The symptoms may be identical or there may be slightly atypical findings due to the position of the diverticulum in the abdomen.

Many patients with Meckel's diverticulum are operated upon with the diagnosis of intestinal obstruction. In such cases it is sufficient to diagnose the obstruction. The obstruction may be caused by numerous mechanisms involving the diverticulum. Cases of volvulus are probably the most common.

Intussusception at the level of the diverticulum is seen and intussusception due to invagination of the diverticulum has been reported. Cases are on record in which an obstruction was caused by Meckel's diverticulum tying a knot around the ileum. A polyp of the diverticulum has caused intussusception to occur in a case of Meckel's diverticulum. Adhesions of the diverticulum may cause internal hernia and obstruction.

An x-ray examination is of little value in the diagnosis of this condition. Golden[9] states that he has never visualized a Meckel's diverticulum in a roentgenogram, even in a case proved by operation. In eleven years at the Duke University Hospital twenty-one patients having Meckel's diverticulum had gastrointestinal x-ray studies, using barium sulfate, but in no case was there any x-ray evidence of the diverticulum.[12] In one of the cases presented herewith the diverticulum was not visualized in a gastrointestinal x-ray series. However, there have been several cases reported in which the diverticulum was demonstrated roentgenographically.[2,11]

About twenty new cases of Meckel's diverticulum are reported annually in medical literature. Although the autopsy incidence of Meckel's diverticulum is about 1.1 per cent, the surgical incidence may be somewhat higher inasmuch as some patients seen at surgery have the diverticulum removed and some patients are operated upon because of disease in or referrable to the diverticulum. Hence, there is greater likelihood of the condition being seen at operation than at autopsy.

Most cases of Meckel's diverticulum appear in children. All of the cases presented herein were in adults. (Table 1.)

SUMMARY OF CASES

Histologically, Case 1 in this series was the most interesting; the diverticulum contained heterotopic pancreatic tissue consisting of typical acini, islands and ducts. In sixty-one cases of Meckel's diverticulum collected for analysis by Howell no patient had ectopic pancreatic tissue.[12] In 1943 Mitchell and Angrist[8] collected twenty-three cases of Meckel's

diverticulum containing pancreatic tissue from the literature up to that time. In December, 1945 Troll added two more. The present case is the only one recorded since that time. Therefore, this is the twenty-sixth case of a Meckel's diverticulum containing pancreatic tissue reported in medical literature to date.

CASE I is also of clinical interest as the patient had an appendectomy performed eight years before for symptoms which persisted after operation. A month before his last hospital admission he was admitted to a hospital with similar symptoms but was discharged after having improved. This case well illustrates the error in not exploring the ileum after an apparently normal appendix has been removed[1,5] although the clinical picture was one of appendicitis. Many surgeons are reluctant to make a second incision in cases of this kind. This is very seldom necessary; the small bowel can be explored with ease through even a McBurney incision. About 1 meter of the terminal ileum should be examined if enough pathologic change is not found in the appendix to justify the diagnosis. If the ileum cannot be delivered, there is likely to be a diverticulum or some other pathologic entity which justifies an exploratory incision. (Fig. 1.)

Case II is interesting because the diverticulum contained an abscess in its distal portion. It also was causing a volvulus, resulting in partial obstruction.

Case III may not represent a true Meckel's diverticulum but rather a duplication of the ileum because of the large diameter of the diverticulum. However, the distinction is too fine and, therefore, the case is included in this series.

Case IV presents no unusual phenomena. The diverticulum was small (about 5 cm. long), asymptomatic and was found on abdominal exploration during a hysterectomy.

No intestinal bleeding was encountered in these cases. This is to be expected in view of the findings in these diverticula. In all cases the diverticulum was excised and the ileum was closed by transverse suture.

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SURGICAL ASPECTS OF PERIPHERAL VASCULAR DISEASE*

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DISEASES of the peripheral arteries may be classified into three main types, degenerative organic, vasospastic organic and vasospastic functional.[20,22]

Organic arterial disease is exemplified by arteriosclerosis. This is by far the most frequent form of arterial disease and is rarely absent in advanced life. Pathologically, the disease is restricted largely to the intima of the large and middle-sized arteries but may encroach upon the media. The intima becomes thickened and degenerative changes are prominent. Calcification occurs in the necrotic areas with progressive obstruction of the lumen of the vessel. In the advanced stages thrombosis occurs and the lumen is filled with recent or partially organized thrombi.

This disease occurs in persons over fifty years of age. It affects both sexes approximately the same and usually affects the lower extremity to a greater degree. The lower legs and feet have a poorer arterial supply than the upper extremity and, therefore, are affected to a greater extent than the arms and hands. The outstanding symptom of arteriosclerotic peripheral vascular disease is intermittent claudication. Patients with this symptom develop severe cramps in the calf of the leg after walking one or two blocks and must sit down and rest until the arterial supply equals the tissue demand. After a period of rest they are able to walk again until the cramping pains recur. They also may complain of cold feet and occasional cyanotic discoloration. Examination usually reveals an absent pulse in the dorsalis pedis and posterior tibial arteries. When the extremity is placed in a dependent position, the color of the toes becomes blue and cyanotic. When the extremity is elevated, the color of the toes becomes white and cadaveric. Impending gangrene with definite discoloration of one or more toes together with early infection or cellulitis spreading up the dorsum of the foot is a common sight in the more advanced cases. Often these patients are not seen until definite gangrene of varying extent has occurred.

Vasospastic organic disease is exemplified by Buerger's disease. Pathologically, the earliest lesion is an acute inflammation of all layers of the artery and veins, with occlusion of the lumen by thrombi. With healing the thrombus becomes organized and the wall fibrotic. The artery, nerve and vein are involved in the inflammatory process and become densely adhered to one another. In addition to the obliterative endarteritis which is present there is marked vasospasm initiated by the inflamed vessels.

This disease occurs in patients under the age of forty. It is seen more often in males and usually involves the lower extremity. These patients also complain of claudication but in addition to intermittent claudication they have rest pain which awakens them at night and causes them to sit on the side of the bed and put their feet in a dependent position. They also may complain of bluish discoloration of the feet and state that their feet are cold and moist. On examination there is usually no pulse felt in the posterior tibial or dorsalis pedis vessels and in advanced stages one may see definite gangrene of the toes and foot.

Vasospastic functional disease is the type in which Raynaud's disease falls. In the early stages this is purely a functional vasospasm without primary organic disease of

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the arteries. In the advanced stages of the disease there may be thickening of the arterioles of the peripheral vessels which have led some authors to believe that Raynaud's disease is primarily a vascular and not a sympathetic disorder.[14]

This condition usually occurs in young women between the ages of fifteen and thirty. The ratio of men to women is about 3:7. More often it involves the upper extremity. Patients with this condition complain of cold hands and fingers, increased sweating and pain in the tips of the fingers. The disease is characterized by a triphasic color change. The fingers first get white or blanched, following which they become cyanotic and blue which, in turn, gives way to a red, flushed appearance. The fingers become hot and tingling with relief from vasospasm and accompanying hyperemia. If this condition is allowed to progress, gangrene develops, usually of the distal end of the finger. Milder cases cause complaints of recurrent ulcers about the fingernails or pads of the fingertips. The condition is aggravated by any emotional upset or exposure to cold.

TREATMENT

Treatment of the arteriosclerotic type of arterial disease is aimed mainly at prophylaxis, that is, to prevent the occurrence of gangrene. Patients with this condition should be instructed carefully in the care of their feet. Extreme care should be used in trimming the toenails so as to avoid injury to the cuticles. Any infection or fungus disease should be cared for promptly. They are not to trim corns or open blisters but should consult their physician in regard to these affections. They are instructed to avoid getting the feet wet and cold for if frost bite occurs, these patients are very likely to develop gangrene. Heavy wool bed socks should be worn in the wintertime to prevent excessive coldness of the feet. An electric heating pad or hot water bottle may be placed on the abdomen at night to produce reflex vasodilation. Heat should not be applied directly to the extremity as it is likely to burn the feet if one is not extremely careful. When there is impending gangrene, contrast baths are of value and can be done without elaborate equipment. These patients are instructed to immerse the feet in warm water for thirty seconds, following which they are placed in cold water for one minute. This is carried on for twenty minutes and by alternating dilatation and constriction a vascular exercise is accomplished which aids in the development of collateral circulation. The Pavex boot has been advocated for this condition; and if there is no infection present, it can be used with good results. These patients are encouraged to take about 1 ounce of alcohol two or three times a day as the vasodilatation which occurs is of definite help. The use of tobacco must be strictly forbidden. It has been shown definitely that nicotine causes vasoconstriction and a fall in the skin temperature especially in these patients who have an incompetent arterial supply. In selected cases lumbar sympathectomy is of definite value. These patients are first tested by doing a lumbar sympathetic block with novocain. If the temperature of the extremity increases and they are relieved of their claudication, sympathectomy is of value in preventing gangrene.

Once gangrene has occurred, treatment is aimed at preventing spread of the gangrene so that no more of the extremities than necessary will be lost. Penicillin or sulfa drugs should be given to prevent secondary infection of the gangrene which is usually a dry gangrene in the beginning. In addition the patient should use a 50 per cent alcohol solution which is applied to a bandage about the extremity and is kept moist continuously. Alcohol has the property of dehydrating the tissue and preventing wet gangrene; at the same time it is bactericidal and prevents further infection. Evaporation of the alcohol also cools the feet slightly and helps decrease the blood demand of the tissues. A lumbar sympathetic block should be done in all cases of gangrene to determine if any vasospastic element is present. If after a

block is done the extremity becomes warmer and the color improves, one must consider doing a sympathectomy as this often will make a difference in the level of amputation which may have to be done. Refrigeration is of definite value following a lumbar sympathetic block or sympathectomy. Interruption of the sympathetic impulses relieves any vasospasm that is present. It opens up collateral circulation and counteracts the vasospastic impulses created by applying cold to the extremity. By cooling the leg the metabolism of the tissue is decreased so that there is less demand for oxygen and the tissue needs can more nearly approach the available blood supply.[4,7] In addition the ice reduces pain, slows the absorption of toxins and discourages bacterial growth.[12,15] The leg first should be wrapped in cotton sheet wadding to protect the skin, following which four or five ice bags are placed about the extremity and a wool blanket wrapped about the legs covering the ice bags. This produces chilling but not freezing of the extremity and reduces the metabolism to a low ebb.

If amputation becomes necessary, one can use either low spinal or refrigeration anesthesia.[5] If refrigeration anesthesia is to be used, a tourniquet is placed just below the anticipated site of amputation and the extremity is packed in cracked ice. Thus the leg is frozen or almost frozen and the amputation can be done just above the site of the tourniquet without any further anesthetic. This is especially valuable in patients whose cardiac or respiratory status does not tolerate a general anesthetic very well. Low spinal anesthesia has proven to be very safe in those patients in whom the vascular system is not too seriously damaged. Spinal procaine anesthesia causes very little fall in blood pressure if confined to the lower neuron segments.

One must not be too conservative in doing amputations for arteriosclerotic gangrene. Occasionally, one may be able to amputate a toe if there is a good line of demarcation and there is no marked infection, but once the process has spread beyond the webs of the toes, the next site of election should be the mid-tibial region. However, if no pulsations are palpable in the popliteal artery, the amputation must be done in the low thigh. We have found the Callander type of operation to be very satisfactory in this region.[8] Those patients in whom the femoral pulse is absent or markedly decreased would do better with an amputation in the middle or high thigh region.

Prophylactic treatment of the Buerger's type of disease is aimed at relief of vasospasm and the increase of blood supply to the affected extremity by opening up collaterals. Again alcohol is indicated in a moderate amount for its vasodilatory action and tobacco must be strictly forbidden in all forms.[13] Lumbar sympathectomy is of definite value to these patients for by relieving vasospasm and developing collaterals, the arterial supply usually will be sufficient to maintain the extremity. It is perfectly true that the sympathectomy had no effect on the progress of Buerger's disease. However, these cases usually run a definite course and eventually "burn out" so that by doing a sympathectomy, gangrene can either be prevented or limited to the distal portion of the extremity. Once definite gangrene has been established, a sympathectomy still should be done. Following sympathectomy the level of amputation can be more conservative and these patients are relieved of a great deal of their ischemic pain.

Treatment of vasospastic functional or Raynaud's type of disease is similar to that of Buerger's disease in that smoking should be avoided and alcohol should be used for vasodilatation. Patients with vasospastic functional disease are extremely sensitive to cold and it is often necessary that they leave a colder climate for one of more moderate temperature. They should be instructed to avoid chilling of the extremity. They should wear gloves in the wintertime and should not expose their hands to cold water or low temperature.

These patients are benefited to a great extent by cervicothoracic sympathectomy. There is still controversy among different authorities as to whether a preganglionic neurectomy or a sympathectic ganglionectomy should be done. Concensus of opinion seems to favor the preganglionic resecting of Smithwick.[10,16,17,24,25] Both methods have their points and, regardless of which type of operation is done, the patient will receive marked benefit by interruption of the sympathetic pathways. Of course, they must continue to avoid exposure to cold and tobacco.

VENOUS CLOTTING

Intravenous clotting has been divided by Ochsner and DeBakey[19,21] into two types, thrombophlebitis and phlebothrombosis. In thrombophlebitis the clot results from an inflammatory reaction in the vein and is firmly attached to the vein wall. Embolism does not occur unless a loosely attached red or coagulation thrombus forms proximal to the fixed white thrombus. On the other hand, in phlebothrombosis the intravenous clot is the red or coagulating variety unassociated with inflammation of the vein wall. In this instance the clot is loosely attached to the vein and may be detached easily to develop an embolus.

Clinically, thrombophlebitis presents the picture of chills, fever, tenderness over the involved vein with increased local heat and marked edema of the extremity. There are many etiologic factors in the production of thrombophlebitis.[9] Among the more important are trauma to the veins, stasis, infection and increased coagulation of the blood.[18] The most important treatment, therefore, is prophylactic. Trauma to the venous system should be specifically avoided. This is especially true in doing pelvic operations in which the operative field is closely adjacent to the larger pelvic veins. Gentleness in handling tissue and clean surgical dissection is important here as always. Following the operation stasis should be prevented. This can be done by the use of bed exercise or by the bed bicycle as advocated by Gamble,[11] but the patient must be made to follow out the prescribed exercises. Compression bandages of the Ace No. 8 variety are of value in collapsing the superficial veins of the lower extremity and prevent slowing of the return blood flow. This is especially true in elderly patients and in any patient who has varicose veins. Bandages should be applied from the toes to the groin and kept in place until the patient becomes ambulatory. The use of early ambulation has been an important factor in reduction of postoperative thrombophlebitis in our experience. At the present time we get all patients, except those with peritonitis or distention, up on the first postoperative day and they are gotten up twice a day thereafter. By the third postoperative day they usually are able to walk to the bathroom. This in itself prevents stasis in the vessels, increases respiration and speeds up the circulation of the blood. Any infection present, especially that in the pelvis, should be combated with the usual surgical measures as infection and toxemia tend to cause intravascular clotting. Of much recent interest has been the use of anticoagulants, especially heparin and dicumarol. It is our policy to administer dicumarol to any patient who we fear might have thrombophlebitis. This includes elderly patients, any patients who have had extensive pelvic surgery or those in whom there has been marked intra-abdominal infection or trauma.[23] Any patient who gives a history of previously having had thrombophlebitis should receive dicumarol therapy to prevent recurrence. Dicumarol is started on the second postoperative day and usually is administered in 300 mg. doses the first day and 100 to 200 mg. doses each day thereafter in which the prothrombin time is thirty-five seconds or less.[6] The prothrombin level must be checked daily and the dosage governed accordingly. Since dicumarol does not act for about forty-eight hours after its administration, sometimes it is necessary to administer heparin until such time as the

dicumarol takes effect. This is given either intravenously or if Pitkin's media is used, it is given intramuscularly. Dosage must be carefully checked by the use of coagulation time.

Once thrombophlebitis has become established, active treatment consists of elevation of the involved extremity, the application of a heat tent and the wrapping of the leg in an elastic bandage to the groin. In addition to these measures dicumarol is started to prevent propagation of the clot which has formed and thus prevents spread or embolism. Lumbar sympathetic blocks should be given every twenty-four to forty-eight hours until there is definite subsidence of the condition. By the use of these measures the course of the disease can be shortened to about seven to ten days. Before institution of these measures thrombophlebitis usually ran a course from six weeks to many months and was followed by grave sequelae.

The clinical picture of phlebothrombosis is not nearly as dramatic as that of thrombophlebitis. The patient has no marked chills or discomfort and rarely complains of pain except for a slight discomfort or soreness in the calf of the leg. He may have an increased pulse out of proportion to his temperature and may be rather anxious about his condition or, as it has been described, "a sense of impending disaster." Examination usually will reveal a positive Homan's sign, that is, tenderness in the calf of the leg on dorsiflexion of the foot. Careful examination of the veins of the calf and the feet usually will elicit some tenderness over the course of the veins. Sometimes a diagnosis of phlebothrombosis is not made until the patient has had a fatal or near fatal pulmonary embolus. If pulmonary embolus has occurred, a meticulous examination must be made to determine from which extremity the clot arose and if it cannot be determined by clinical signs, one must consider ligating the superficial femoral vein of both legs.[1–3] Once the site of thrombosis has been determined, the veins must be ligated proximal to the site of the clot to prevent further embolic phenomena. Anticoagulants also should be administered to prevent formation of clots in the veins of the other extremity or at other sites.

POSTPHLEBITIC EDEMA

Edema, which follows a phlebitis that has not been actively treated or has been very severe, is often a discouraging and debilitating condition. The patient gives a history of having had thrombophlebitis, usually following delivery or operation, and complains of persistent edema of the legs that may last for months or years following the initial onset of phlebitis. Some of the patients with this history are almost completely debilitated, are unable to stand or walk for any length of time because of the heaviness and aching sensation accompanying the marked edema of the extremities. The edema is due to persistent reflex arteriospasm resulting from the chronic inflammatory reaction which remains in the veins following phlebitis.

The treatment consists of urging patients to wear elastic hose to prevent the edema together with giving repeated lumbar sympathetic blocks to relieve arteriospasm and reduce the edema. Those patients who do not respond completely to repeated lumbar sympathetic blocks should have a permanent sympathectomy done. The improvement following sympathectomy is not dramatic, but persistent vasodilation over long periods of time will gradually decrease the amount of edema present and usually will allow these patients to return to their normal activities.

SUMMARY AND CONCLUSIONS

1. Diseases of the peripheral arteries have been discussed under the classification of (1) degenerative organic disease (arteriosclerosis); (2) vasospastic organic disease (Buerger's); and (3) vasospastic functional disease (Raynaud's).

2. Treatment of arteriosclerosis is aimed mainly toward the prevention of gangrene.

Once gangrene has occurred, amputation is indicated but the levels of amputation may be modified by interruption of the sympathetic nerves. The value of refrigeration is discussed.

3. Buerger's disease is best treated by abstinence from tobacco, the moderate uses of alcohol and sympathectomy.

4. Raynaud's disease is generally conceded to be vasospastic in origin, based on a hypersensitive sympathetic reaction to tobacco, cold or emotional upset. Cervicothoracic preganglionic sympathectomy is the treatment of choice.

5. Venous clotting has been discussed under the heading of thrombophlebitis, phlebothrombosis and postphlebitic edema. Emphasis has been placed on prophylaxis.

6. Sympathetic blocks and anticoagulants are advocated for thrombophlebitis.

7. The dangers of embolism in phlebothrombosis have been stressed and the use of vein ligation together with anticoagulants has been discussed.

8. Postphlebitic edema is a debilitating disease. Sympathetic nerve interruption is of definite value in rehabilitation.

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GLYCERITE OF HYDROGEN PEROXIDE*

A COMPARISON OF ITS BACTERIOTOXIC EFFECT ON CLOSTRIDIA WITH THAT OF OTHER ANTISEPTICS

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WHEN it was found that relatively stable solutions of urea peroxide[3] and of hydrogen peroxide[6] in substantially anhydrous glycerol could be prepared, studies were made of its bacteriologic and toxicologic properties.

Comparisons of the peroxide solutions with mercurial solutions[4] and with iodine solutions[5] by a cylinder plate method have been reported. The physiologic properties of the peroxide-glycerol solution have been described.[1,2] The present paper records the results obtained in comparing the action of glycerite of hydrogen peroxide on Clostridium welchii and Clostridium tetani with that of thirty-two commercial antiseptic solutions.

Aqueous peroxide solutions have been used to a considerable extent and urea peroxide crystals to a lesser extent in the treatment of anaerobic infections. Many references in the literature[7,16] refer to lavage with peroxide solutions. Some workers have injected such solutions. The latter procedure is accompanied by considerable danger due to embolus[9] or gas formation in the tissues.[8] Peroxide solutions obviously should not be used in closed spaces. Meleney[11] recommends thorough exposure of the affected tissue to the active agent. This holds true for all topical applications, regardless of the type of medication. The poor results reported for some peroxide compositions[10] appear to be due, in part at least, to failure in following this recommendation. Another possible error is due to the fact that peroxide solutions in the usual concentrations are relatively slow in their bactericidal action and hence must be in contact continuously with the organisms. Many of the commercial antiseptic solutions, such as some of the mercurial solutions, have a rapid bacteriotoxic and slower (frequently much slower than peroxide) bactericidal action.

As in the other comparison studies previously published, a cup plate technic[15] modified by the use of glass or porcelain cylinders was used. The method was described in the first paper of the series[4] and consisted essentially as follows: Difco dextrose agar, with and without 10 per cent added horse serum, was preinoculated with 0.2 ml. of a twenty-two to twenty-six-hour culture of the organism for each 25 ml. of melted agar. After the poured plate (100 mm. diameter) had hardened, slightly warmed cylinders, 8 mm. in outside diameter the rims of which had been paraffined, were placed on the agar. The solution to be tested was placed in the cylinders in 0.2 ml. amounts. The plates were immediately incubated anaerobically[13] for eighteen hours. Subcultures of approximately 3 mm. cross section were taken radially from the edge of the cup and placed in modified Brewer's thioglycollate medium and incubated at 37°C. for at least seven days.

After subculturing, the distance of the outer edge of the clear zone, if any, to the outer edge of the cup was measured to the nearest 0.5 mm. and recorded for each cylinder. At the same time the distance from the edge of the cylinder to the inner and outer edge of the indentation left by the removal of material for subculturing was measured and recorded. Because of space limitations the table shows only the average distal measurement of the subculture area closest to the cup that showed

* The expenses for this study were defrayed in part by The Asthma Research Foundation, Inc., of Boston, Mass.

growth in the subculture tube. This procedure obviously favors the antiseptic. At least three, and in some cases more, replicate tests were made. The values in the table have been rounded off to the nearest whole number since this is sufficient for comparative purposes. (Table 1.)

Although solutions of urea peroxide in glycerol are in general more stable than similar solutions in water, some lots of glycerol yield solutions that are less stable than others. Hydrogen peroxide solutions in glycerol are apparently of short life in the absence of stabilizing agents. It was

TABLE 1

BACTERIOTOXIC ACTION OF ANTISEPTIC SOLUTIONS ON CLOSTRIDIUM WELCHII AND CLOSTRIDIUM TETANI IN THE PRESENCE AND ABSENCE OF 10 PER CENT HORSE SERUM

Solution*	Clostridium Welchii		Clostridium Tetani	
	Plain	10% Serum	Plain	10% Serum
Glycerite of hydrogen peroxide	18†	26	39	39
Glycerite of hydrogen peroxide (with urea)	20	20	33	34
Glycerite of hydrogen peroxide (with oxine)	25	15	41	28
Glycerite of hydrogen peroxide (with oxine and urea)	22	21	37	37
Tincture of hydrogen peroxide	21	26	35	35
Glycerol saturated with oxine	2	10	3	4
Mercresin, tincture 1:1000	9	7	15	11
Mercurochrome aqueous 2%	3	6	11	10
Mercurochrome, surgical 2%	5	3	19	12
Metaphen, tincture 1:200	10	8	16	13
Metaphen, aqueous 1:500	5	4	15	8
Merthiolate, tincture 1:1000	7	3	19	11
Merthiolate, aqueous 1:1000	3	4	13	10
Merthiolate, glycerite 1:1000	8	5	15	6
Merseptal, tincture 1:500	3	8	14	10
Merseptal, aqueous 1:1500	3	3	15	10
Merbromin, surgical 2%	5	9	23	13
Merbromin, aqueous 2%	3	5	14	9
Iodine, tincture USP 7%	26	19	42	39
Iodine, tincture mild 2%	13	8	31	21
Biodone (aqueous iodine) 2%	9	9	21	18
Iodine, aqueous N.F. 2%	6	4	17	14
Iodine, glycerite 2%	9	11	27	19
Zephiran, tincture 1:1000	2	2	8	3
Zephiran, aqueous 1:1000	2	2	6	5
Phemerol, tincture 1:500	3	3	6	3
Phemerol, aqueous 1:1000	2	3	5	3
Cepacol, tincture 1:4000	3	2	0	0
Ceepryn, tincture 1:500	0	0	0	0
Ceepryn, aqueous 1:1000	0	0	0	0
Acriflavine (1:1000)	3	3	5	7
S.T. 37 1:1000	8	3	8	4
Azochloramide (1:3300)	3	2	6	7
Tenicide	8	6	25	13
Auralgan	6	16	5	3
Otosmosan	3	4	4	4
Otomide	3	11	34	14
Lysol (1:64)	8	0	6	5

* The commercial antiseptics were used full strength except where the concentration is given in parentheses.
† Subculture zones were measured radially in mm. from the edge of the cylinder.

found that the addition of small amounts of oxine (8-hydroxyquinoline) resulted in greater stability with all lots of glycerol and permitted the use of concentrated hydrogen peroxide (90 per cent) in making stable solutions.

The solutions tested, with their concentrations, are shown in the table and will not be relisted here, except for the peroxide compositions and some lesser known solutions which are mixtures. The composition of the peroxide solutions was as follows:

Glycerite of hydrogen peroxide: hydrogen peroxide 1.5 per cent in glycerol
Glycerite of hydrogen peroxide with urea: urea peroxide 4 per cent in glycerol
Glycerite of hydrogen peroxide with oxine: hydrogen peroxide 1.5 per cent; oxine 0.1 per cent in glycerol
Glycerite of hydrogen peroxide with oxine and urea: urea peroxide 4 per cent: oxine 0.1 per cent in glycerol
Tincture of hydrogen peroxide: urea peroxide 4 per cent; oxine 0.1 per cent in alcohol 50 per cent; acetone 10 per cent; water 40 per cent

The compositions of the following are those shown on the respective labels.

Otomide: sulfanilamide 5 per cent; urea 10 per cent; chlorbutanol 3 per cent; glycerol
Auralgan: antipyrine 0.87 Gm.; benzocaine 0.23 Gm.; glycerol 0.463 fl. oz.
Otosmosan: urea 2.4 Gm.; sulfathiazole 2.02 Gm.; benzocaine 0.20 Gm.; glycerol 20.0 Gm.
Tenicide: alcohol 56 per cent; chloroform 8 per cent; iodine (total) 1.2 per cent; zinc sulfocarbolate, salicylic acid, formaldehyde, thymol and camphor

COMMENT

The control solutions, "tincture solvent" (50 per cent alcohol, 10 per cent acetone, 40 per cent water) glycerol and alcohol 70 per cent gave no zones under the experimental conditions.

With the exception of U.S.P. tincture of iodine which was essentially equal in potency, the glycerite of hydrogen peroxide compositions were far more effective in bactericidal action than any of the other thirty-two solutions. This is to be expected somewhat because of the oxidizing nature of the solutions and the anaerobic character of the organisms. That this activity was not due to the presence of free oxygen in the space above the plate is indicated by positive subcultures. If aerobic conditions were present due to free oxygen, it would be expected that no growth would appear. Some visible growth was apparent in all the plates.

The presence of serum appeared to have less effect on the bacteriotoxic activity of the majority of solutions than was the case with aerobic cultures.

The strain of Cl. tetani used proved to be more susceptible to all the antiseptics but more particularly to the peroxides than was Cl. welchii.

All the mercurial solutions showed effects of essentially the same order. The cationic solutions showed the usual low degree of activity. The point has been made[14] that tests using agar are not suitable for the evaluation of quaternary ammonium salts. Since both agar and tissue have an electric charge of the same sign it would seem that the use of agar would give a better indication of the activity of cationic substances on massive tissue areas than the use of methods which do not use material with a charge of the same sign as that of the tissue on which it is to be used. The formation of a surface film on skin[12] with viable organisms underneath would seem to bear this out.

Otomide containing a 5 per cent sulfanilamide showed a considerable zone with Cl. tetani, a much smaller one with Cl. welchii. The iodine solutions showed more activity with Cl. tetani than with Cl. welchii.

SUMMARY

In cylinder plate tests on Cl. welchii and Cl. tetani glycerite of hydrogen peroxide solutions showed much greater activity than did thirty-two other antiseptic solutions with the exception of U.S.P. tincture of iodine. Twelve mercurial solutions showed less activity than did the peroxide

solutions and were of about equal activity when compared with each other. Seven cationic solutions failed to demonstrate activity in several cases and were of slight effect in other cases. Otomide, a solution containing sulfanilamide, produced a zone of considerable size with Cl. tetani.

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SURGICAL MANAGEMENT OF THE MORIBUND BURN PATIENT

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EXTENSIVE burns are critical burns which are a threat to life. Anemia and hypoproteinemia make their appearance early due to the toxic changes and vast amounts of protein lost from the burned surfaces and kidneys. Progressive debility occurs in direct proportion to the extent of the exposed burned surfaces. The more extensive the burn, the more difficult the process of maintaining physiologic blood levels and the more debilitated the patient becomes. As skin grafting procedures are carried out diminishing the total exposed body surface, the toxic processes diminish. The erythrocytes are not destroyed so quickly and proteins are conserved.

Careful medical therapy is essential in attempting maintenance of normal physiochemical levels. Once they have been materially lowered it is extremely difficult to elevate them to approach the normal. In extensive burns medical therapy alone cannot maintain these levels. Spontaneous epithelialization or skin grafting must be in advance of the chemical processes which tend to emaciate the burn patient.

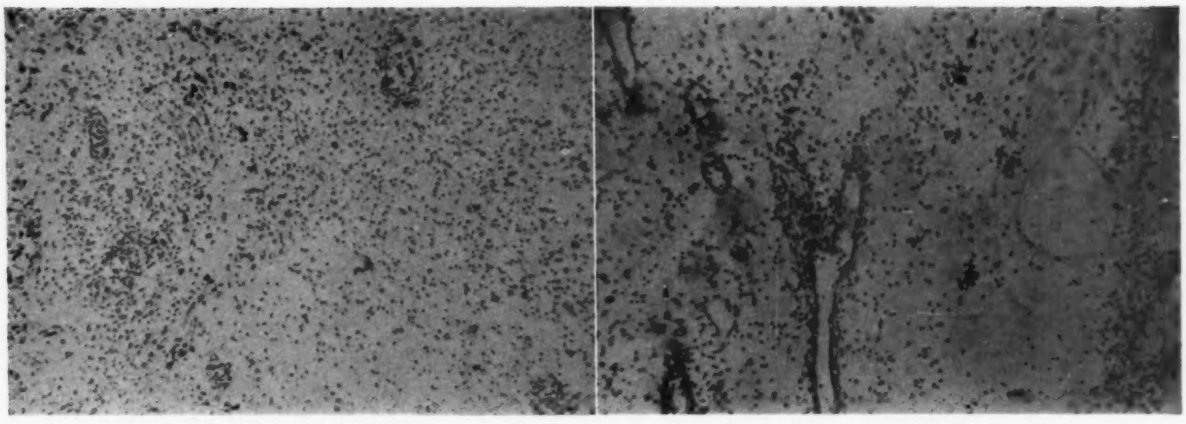
In a previous communication[2] it was pointed out that thin dermatome skin grafts would take well in moribund burn patients with the hemoglobin as low as 30 per cent and the plasma protein level as low as 5 in the presence of infection.

It is the purpose of this paper to discuss a rapid non-shocking technic of skin grafting which has been found to be successful in the treatment of moribund burn patients.

MANAGEMENT OF THE EXHUBERANT GRANULATIONS

Early operation is highly desirous when treating burn patients who require skin grafting. The time to graft is when the recipient area is free from débris and has assumed a clear, healthy appearance. This period is inconstant and varies with each individual case. Cope et al.[1] showed by a large series of cases that "the ideal treatment, that is excision of the full-thickness wound destruction within the first hours after injury with immediate closure of the wound by split thickness grafts" worked out extraordinarily well. If for any reason operation has been delayed, soft pliable granulations may be present which bleed freely with a minimum of manipulation. Occlusion dressings tend to keep them in check. If the dressing is dry, unnecessary large quantities of blood may be lost with each change of dressing. Moore et al.[7] found that "a loss of 75 to 150 cc. of whole blood was determined each time the dressings were changed and a loss up to 200 cc. with each grafting." A layer of petrolatum-impregnated gauze under the pressure bandage will minimize the blood loss with dressing changes.

It is universally accepted that for the best results in delayed skin grafting, the exhuberant granulations should be removed before applying the graft. This is a sound grafting principle. When exhuberant granulations are shaved or scraped down, marked capillary oozing occurs with the loss of 250 to 500 cc. of blood. In most grafting procedures this blood loss is well tolerated by the patient with little ill effect. In moribund burn patients any procedure which tends to cause an excessive blood loss is dangerous and best omitted. Besides the deleterious effect of further diminishing the blood stores, excessive bleeding prolongs the operation and enhances the shock and depressing action of the anesthetic.



1A 1B

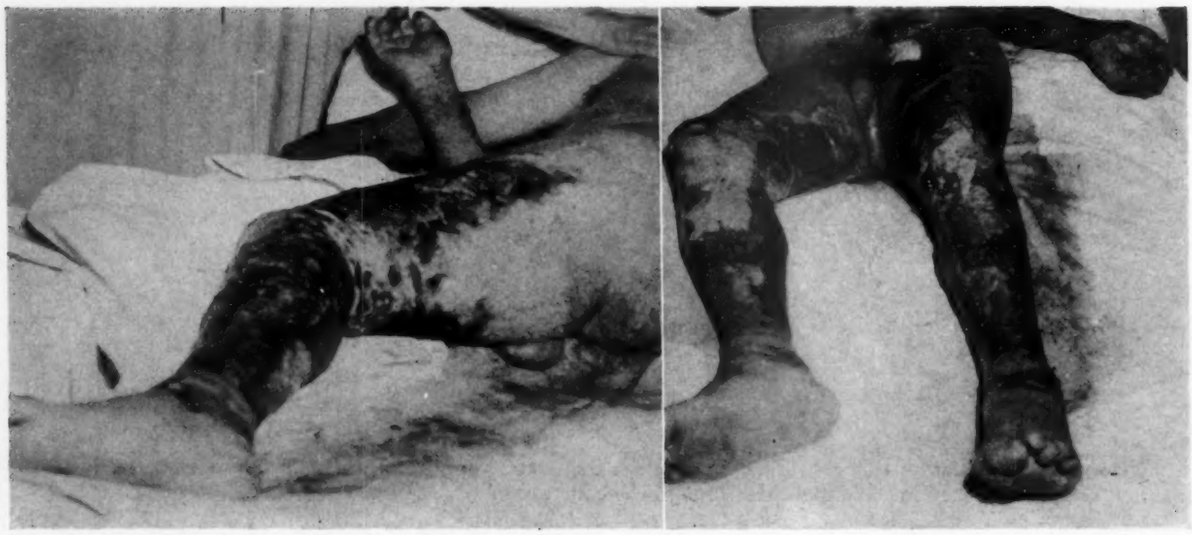
FIG. 1. A, burn granulation tissue. B, burn granulation tissue after application of tincture merthiolate. Note the marked edematous reaction. (Photographs through the courtesy of Dr. Arturo R. Casilli.)

In debilitated persons with extensive burns the exhuberant granulations are not pared down. Whole sheets of dermatome grafts (Thiersh, thin split thickness, thick split thickness), postage stamp and checker board grafts have been cut and directly applied to the exhuberant granulations without any preparation of the recipient area. No great difference has been noted in the percentage of "takes" of grafts applied in this manner as compared with those orthodoxically applied to shaved granular areas. A similar stable covering is formed. Grafts applied to exhuberant granulations bulging above the surface level took well with no final surface elevation or bulge.

PREPARATION OF THE RECIPIENT GRANULATION SITE

Burned denuded surfaces are contaminated surfaces and are treated as such. Should a discharge be present, it is removed by continuous cold saline or penicillin-saline solutions for several days prior to operation. If the wound is infected, it is surgically prepared by a daily change of dressing with the application of a thin coating of sulfathiazole powder and a continuous wet dressing of 1:3300 aqueous azochloramide. When the infection has cleared up, treatment for several days by continuous cold saline dressings ensures a clean surface ready for grafting. If the surface is clear and no discharge is apparent when the dressings are changed, no preparation of the recipient area or contiguous burned area is attempted. The whole undamaged skin surrounding the recipient site is prepared with antiseptics and draped with sterile drapes. The burned areas are untouched and are ready for grafting. Repeated observation has shown that when common antiseptics (merthiolate, metaphen, alcohol, iodine, etc.) are applied to healthy granulations a severe edematous reaction occurs. In those cases in which the granulations were flat, stabile, non-exhuberant and suitable for skin grafting without paring, marked edema occurred a few minutes after the local application of the antiseptics. (Fig. 1.) The antiseptics exert a strong irritant effect and marked swelling rapidly occurs. In cases in which the granulations were flush to the skin not requiring paring, paring was required after the application of the antiseptics.

Extensively burned patients tend to run a continuous spiking temperature. If large areas are exposed or the wounds are infected, the temperature may spike to 102°F. to 104°F. daily. As grafting continues and the body is resurfaced, the temperature spikes to less higher levels. When the body is almost completely resurfaced, the temperature spontaneously drops to normal. Temperature elevation probably results from the absorption of toxins from the burn surfaces as it is pres-



2A 2B

FIG. 2. A and B, extensive tar pitch burns of both legs, left hand and arm.

2C 2D

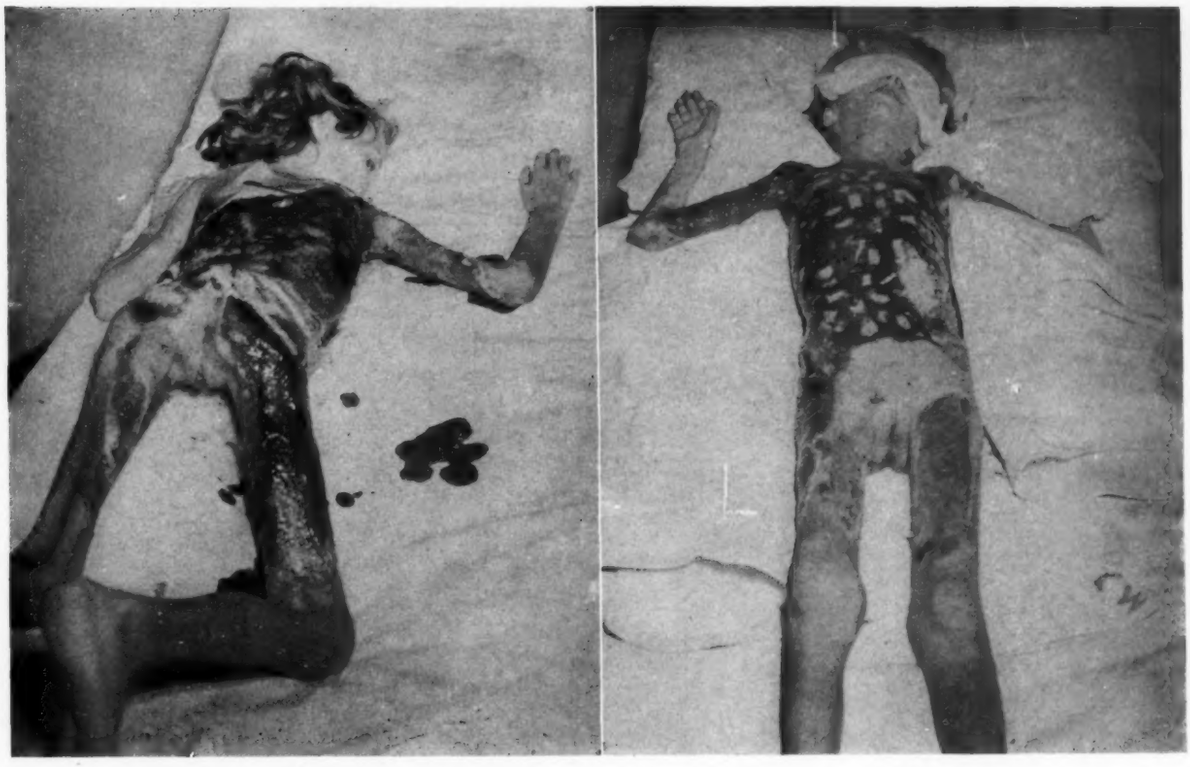
FIG. 2. C and D, postoperative result after split-thickness dermatome whole sheath and checker-board grafts.

ent even when the blood count and chemistry are normal and the burn surfaces are clean. It is further noted that extensive burns treated by tanning agents (tannic acid and gentian violet) (Fig. 2) were more toxic than those tended by vaseline-gauze occlusion dressings. A purulent discharge was usually found under the thick tan.

Small burned areas with exhuberant granulations are cauterized by tri-chloracetic acid and dressed with vaseline gauze and a pressure bandage.

TECHNIC OF OPERATION

With the aforementioned principles in mind, a quick efficient and non-shocking



3A 3B

FIG. 3. A, extensive flame burn (dress caught on fire) of whole back, right arm and leg. B, showing extent of burn of abdominal and chest wall. Postage stamp dermatome grafts ten days after application are evident.

method of resurfacing extensive burns in cachectic patients is as follows: The patient is placed in the desired position on the operating table. The donor areas are surgically prepared and draped. Non-sterile assistants remove the dressings from the denuded recipient areas and the part is simply draped with sterile sheets. Antiseptics are applied to healed areas but none are applied to the recipient site. Cement is applied to the donor areas and dermatomes (several are employed). When the cement is dry, gas and oxygen are administered and the grafts are cut. (Two to four drums may be cut in a few minutes.) The anesthetic is discontinued and the donor sites dressed by sulfathiazole powder, vaseline gauze and pressure dressings. The grafts may be applied in whole sheaths or patterned after Poth,[8] Gabarro,[3] Hardy,[4] Jenny,[5] Eisenstodt[2] or Urkov[9] and applied to the recipient sites. They are merely placed *in situ* or may be fixed by loose running catgut sutures. Vaseline gauze and a pressure dressing are applied. This technic offers a minimum of trauma, operating time, blood loss and anesthetic. Strict surgical asepsis is maintained on the sterile donor site. Sterile technic is also carried out on the contaminated recipient site.

The patient's present general condition and anticipated future condition is carefully appraised. A plan for surgery is established. If the skin available for transplantation is deficient or the patient's condition will not permit repeated long surgical procedures, postage stamp, checker board or strip grafts are advantageously employed. They are placed over large flat surfaces and are not employed over joints. After an interval of ten days one may observe the circumferential proliferation of these grafts. (Fig. 3.) If one estimates the patient to be capable of undergoing multiple operations, the grafting of large sheaths of skin is preferable and a better skin cover is formed. Burn scar margins are not debrided. Secondary plastic procedures may

4A 4B

FIG. 4. A and B, extensive chemical burns (nitric and sulfuric acids) of whole face, ear, neck, arms and legs.

5A 5B

FIG. 5. A, extensive flame burn of right leg showing contracture deformity (pinch grafts had been applied to the popliteal fossa.) B, postoperative result after excision of all contractures and exhuberant tissue with repair by whole sheaths of split-thickness dermatome grafts.

be performed when the patient is better able to tolerate surgery.

A set formula cannot be applied to each case. One must modify his technic to meet the situation. With the above technic successful end results have been obtained in serious burn cases. The greater part of each graft has taken successfully. Clinically no difference has been observed in the percentage of "take" or quality of the final graft cover between grafts applied directly to exhuberant granulations and those applied to pared granulations.

Successful homogenous transplantations of pinch grafts with microscopic verification has been recently reported by Mandl.[6] This will undoubtedly stimulate further study and experimentation in the field of homogenous grafting. (Figs. 4 and 5.)

TROPHIC MANIFESTATIONS

Several weeks after a severe burn has healed vasomotor disturbances occur in those areas which epithelialized spontaneously. These sites assume a purple-reddish hue and are dry and scaly. Patients complain of severe burning and itching. Strangely enough these manifestations are not present in those areas which were skin grafted. It is not uncommon to discharge a burned patient as completely healed only to find he returns a few weeks later with extensive epidermal excoriations on the re-epithilialized sites. They are caused by continuous vigorous scratching. Occasionally a generalized pruritis occurs over the whole body but is absent in those areas covered by large sheaths of grafts. Olive oil, anti-pruritic lotions and vitamin B complex therapy are helpful to tide the patients over these episodes. The intensity of the symptoms diminish with time.

CONCLUSIONS

1. A rapid efficient non-shocking method of resurfacing extensive burn surfaces in moribund patients has been described.

2. Common antiseptics (merthiolate, metaphen, alcohol, iodine, etc.) are strong surface irritants causing a severe edematous reaction when applied to flat, stabile non-exhuberant granulations. In moribund extensively burned patients it is believed that the use of these antiseptics is contraindicated in the preparation of the granular recipient site.

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BILIARY SURGERY THROUGH TRANSVERSE INCISION

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THE following is a report of 100 consecutive gallbladder operations taken from the files of St. Vincent's Hospital, Green Bay, Wisconsin. In each of these cases the technic used was identical. (Tables I, II, and III.)

TABLE I

Sex	Per cent	Hospital Days	Per cent
Male.....	19	Under 10 days	66
Female.....	81	Over 10 days	34

TABLE II

Age	Per cent	Pathology	Per cent
15 to 30 yr.	15	Cholelithiasis	63
30 to 60 yr.	76	Choledocholithiasis	2
60 to 75 yr.	9	Cholecystitis	35

TABLE III

Mortality	Per cent
Cerebral hemorrhage—10th postoperative day..	1
Cerebral hemorrhage—13th postoperative day...	1

Additional surgery performed during the same hospitalization period which was not appendiceal was as follows: one bilateral varicose vein ligation, one umbilical hernia, one thyroidectomy and one hysterectomy.

A transverse incision was employed extending from about 7 cm. above the umbilicus, in the midline laterally, to the rib margin. The rectus sheath and muscle were incised transversely as was the peritoneum. After exploring the liver, stomach, intestines and the common duct the gallbladder was grasped and lifted up into the incision. The cystic duct and artery were ligated separately with No. 0 chromic catgut. No drainage was employed except in the two cases of choledocholithiasis in which a "T" tube was utilized. The anterior rectus fascia was closed with interrupted No. 30 quilting cotton. Interrupted dermal sutures were used to close the skin.

The patients were allowed out of bed the second to third day. They were comparatively comfortable. The lessened pain was due to decreased incidence of injury to the spinal nerves, the absence of a drain and much less tension on the incision. In checking this group we found no instance in which the cotton sutures were extruded from the wound and no case of wound dehiscence. The tendency toward keloid formation seemed to be decreased and there were fewer instances of tenderness along the incisions than when other types of incisions had been employed. No postoperative hernias or bulging of the abdominal wall occurred, as is too frequently seen in other incisions in which there are more spinal nerves cut.

Upon the whole the patients in this group had fewer complaints than those in any similar group observed in which a different technic was employed. The incidence of postoperative hernias following cholecystectomy is generally reported by many surgical clinics as varying from 10 to 20 per cent. This is due to many causes, namely, severance of the spinal nerves, infections in the wound, insertion of a drain and increased tension on the hockey stick vertical or diagonal incisions.

Drains should be employed only in cases of abscess formation or free pus inasmuch as they increase the patient's discomfort and predispose to the development of adhesions and postoperative hernias. It appears that the use of cotton for fascial closure will aid in preventing those few cases of wound disruption which occasionally occur in debilitated subjects. As far as exposure is concerned it frequently is

better with a transverse incision than when other types of incisions are used, all of which cut the spinal nerves. Gas pains were exceptionally rare in this series and it is believed were due, in part at least, to lack of irritation from a drain.

CONCLUSIONS

A transverse incision has the following advantages: 1. The wound closes naturally with less tension; 2. the incision is more comfortable. 3. it provides earlier ambulation and more rapid convalescence with shorter hospital confinement. 4. there are less postoperative pulmonary complications because deep breathing is less restricted; 5. the possibility of postoperative herniation and evisceration is decreased; 6. such an incision leaves a smoother, less sensitive scar.

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At present the operative mortality of total pancreatectomy is high even in skilled hands. However, there is no other suitable treatment for extensive cancer of the pancreas. Postoperative diabetes occurs and the average patient requires some 50 units of insulin daily to overcome the metabolic effects of diabetes on an average diet. This patient also should be given 15 Gm. of pancreatin (or its equivalent) daily to help in the proper digestion of fats and proteins. The average patient tolerates carbohydrates well but should be on a low fat diet if he wishes to enjoy an uneventful postoperative convalescence. (*Richard A. Leonardo, M.D.*)

Case Reports

VOLVULUS OF THE SMALL INTESTINE REQUIRING MASSIVE RESECTION*

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Volvulus of the small intestine alone is uncommon and relatively few reports of this condition have appeared in the literature.[1] With no history of a previous operation resulting in adhesions no abdominal distention or classical signs of intestinal obstruction, the diagnosis is difficult and often impossible. Nevertheless, the recognition that a surgical emergency exists becomes quite evident.

Various etiologic factors have been shown to exist and occasionally there are instances in which no definite cause can be determined. In the series presented by McKechnie and Priestley there was a preponderance of male patients; ages ranged from the newborn to seventy-eight years of age, with the greatest incidence occurring in the third decade of life. In all cases reported there is a partial fixation of one segment of the bowel with normal mobility of another segment, allowing rotation of the intestine around the base of the mesentery with formation of a volvulus.

Contributing to this mechanism may be congenital anomalies, Meckel's diverticulum, malrotation of the large intestine, unusual length and mobility of the mesentery of the small intestine, exomphalos, peritoneal adhesions (congenital or acquired),[2] mesenteric cysts, habitual constipation and chronic intestinal stasis.

CASE REPORT

A white woman, twenty-three years of age, was admitted to the hospital on January 19, 1945. Two days previously she was seen in the out-patient department complaining of severe upper midline, abdominal, cramp-like pain. The pain came on suddenly, approximately nine hours before admission, and was intermittent in its severity. It was followed by nausea and frequent vomiting. Defecation had occurred a few hours before admission.

She had her onset of menses at the age of thirteen. Her periods were always regular, occurring every twenty-eight days and lasting for four or five days. Her last menstrual period was approximately three and a half weeks prior to admission to the hospital. She had never been pregnant. There was no history of recent upper respiratory infection and no urinary symptoms were present.

Approximately one month before admission she had an attack of upper abdominal pain which came on suddenly and which was associated with nausea and vomiting. The symptoms were followed by moderate anorexia and gradually subsided over a period of one week. Meanwhile, she had felt physically normal. Defecation had occurred regularly and the stools had been of a normal character.

Physical examination revealed no masses and no special rigidity of the abdomen but she did complain of tenderness when pressure was made in the epigastrium. Emesis of bile-colored liquid occurred during the examination. Vaginal examination revealed a normal uterus and normal adnexae. The temperature, pulse, blood pressure, respirations, blood count and urinalysis were essentially normal. The diagnosis of pylorospasm was made and she was given $\frac{1}{150}$ gr. of atropine. This brought relief twenty minutes later and the patient was well enough to be discharged from the hospital.

A few hours following her dismissal from

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the out-patient department her symptoms returned but she sought no medical care until 2 A.M. on the day of admission, at which time her physician gave her 1½ gr. of morphine sulfate. She obtained no relief and was sent to the hospital for admission.

On admission at 3 A.M. the patient was found to be suffering from excruciating upper abdominal pain, nausea and vomiting. Her blood pressure was 124/90, pulse 112, temperature 97.6°F. and respiration 22. Her pupils were constricted but otherwise the head and thorax showed no abnormality. The abdomen was flat and quiet and did not move with respiration. General abdominal tenderness and rigidity to a marked degree were present at 6 A.M. The patient suddenly presented the picture of shock. Her blood pressure was not obtainable and her pulse was 110, temperature 98°F. (per rectum) and respirations 24. Urinalysis showed acid reaction, specific gravity 1.031, albumin 2 plus, sugar 1 plus or 1.11 per cent and acetone 1 plus. Diacetic acid was absent. Microscopic examination was essentially negative. Her blood count was as follows: red blood cells 4,160,000; hemoglobin 41.3 per cent, or 5.9 Gm.; white blood cells 28,900; segmented neutrophils 73; non-segmented neutrophils 24; lymphocytes 3.

The diagnosis of acute hemorrhagic pancreatitis or ruptured peptic ulcer was made. The patient was given 500 cc. of plasma and 1,000 cc. of whole blood. During the period of shock the pain seemed to diminish and shift to the lower abdomen. By 2:15 P.M. a firm, tender swelling was apparent to inspection as well as palpation in the lower abdomen. This gradually increased in size, filling the lower half of the abdomen and presenting mobility, but no peristaltic sounds were heard. At 2:40 P.M. under sodium pentothal and local anesthesia a right rectus incision was made 5½ inches in length opposite the umbilicus. The abdomen contained a large amount of serosanguineous fluid. Several loops of dilated, blood-filled, gangrenous small intestine appeared immediately. The involved loops of bowel were delivered from the abdomen and by gentle palpation, the mesentery of the small intestine was found to be twisted upon itself. There was a mesenteric band originating from the mid-portion of the base of the mesentery and attaching itself to the mesenteric border of the bowel which had to be severed before detortion could be accomplished. The proximal 5 to 6 inches of jejunum and terminal 5 inches of ileum appeared to be normal but the intervening small intestine, as well as the mesentery, showed massive infarction with necrosis of the bowel wall. The entire mesentery of the small intestine was twisted three times upon itself in clockwise fashion. Following detortion only the proximal jejunum and terminal ileum, as mentioned previously, showed evidence of viability. Accordingly, the involved gangrenous bowel (Fig. 1) was resected and an end-to-end aseptic anastomosis of the remaining jejunum and ileum was done. The stomach, entire colon and appendix were visualized and appeared to be normal. Five Gm. of sulfanilamide crystals were placed in the abdominal cavity and the abdomen was closed without drainage. The postoperative diagnosis of volvulus of the small intestine was made. Two hundred thirty-five cm. of small bowel were resected, allowing approximately 18 inches of small bowel to remain.

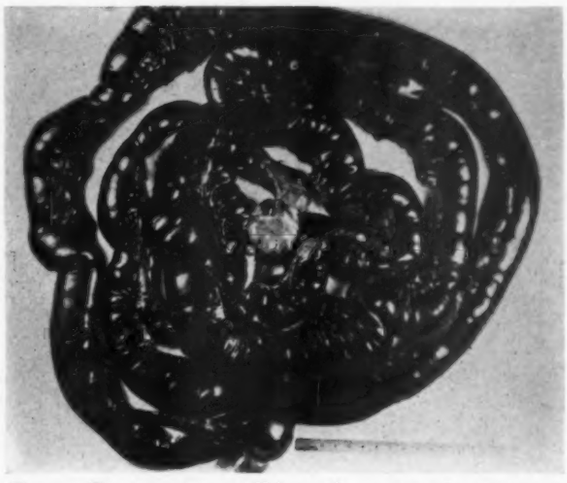

FIG. 1. Gangrenous small intestine measuring 235 cm.

During the operation the patient received 500 cc. of glucose in distilled water and 3 units, or a total of 750 cc., of plasma. Drop ether supplemented the local and pentothal anesthesia.

The patient's postoperative course was supported by the following measures: (1) use of rectal tube; (2) continuous Wangensteen suction; (3) 2,000 cc. daily for forty-eight hours of amigen; 1,000 cc. glucose in normal saline; (4) plasma; (5) blood; (6) cevitamic acid, 100 mg. daily, thiamine chloride, 100 mg. daily; and (7) pantapon for pain.

Following the operation her temperature, taken per rectum, rose to 102.8°F. and gradu-

FIG. 2. X-ray showing stomach and remaining small intestine.

ally returned to normal by the eleventh postoperative day. On the third postoperative day defecation occurred. On the fourth day a liquid diet was started; on the fifth day a semi-liquid diet was given. A light diet was given on the seventh day; on the ninth postoperative day the patient was allowed out of bed. On the tenth day purulent drainage came from her incision which entirely disappeared five days after its appearance. She was placed upon a non-residue diet and was dismissed on her seventeenth hospital day.

Her nutritional state has been maintained quite satisfactorily. Her weight before operation was usually 114 pounds; twelve months after operation it was 111½ pounds. Her appetite has been good and when she follows her prescribed diet (high carbohydrate, high protein, low fat, supplemented with vitamins), defecation occurs only once daily, the stool being normal in character. Digression from her diet would cause frequent defecation of partially digested food. There has been minimal abdominal discomfort.

During the first eight postoperative months she tired easily. Recently she stated that she felt better and had a greater sense of well being than she had experienced preoperatively.

Estimations of blood sugar, non-protein nitrogen, total proteins, chloride, albumin and globulin were made twice during her postoperative period and were within normal limits except for the chlorides which were low at first and later approached normal.

Complete blood counts were repeatedly satisfactory. Her last count, sixteen months postoperatively, showed red blood cells 4,030,000, hemoglobin 11.5 Gm. and white blood cells 4,400, with a normal differential. Her sedimentation rate has been normal.

COMMENTS

Treves states that in 100 cases the average length of the small intestine in the adult male was 22 feet and 6 inches and in the adult female, 23 feet and 4 inches. He said, however, that it varies very much, the extreme in the male being 31 feet and 10 inches, and 15 feet and 6 inches. The term massive resection[3] is applied to those cases in which 200 cm. or more of small bowel has been resected. This generally is estimated to be one-third the total length of the small intestine.

Obviously, the amount of small intestine resected has a definite bearing upon the postoperative morbidity and mortality but the amount of small bowel that remains following resection should be the factor determining the ultimate nutritional status of the patient. Prioleau states that, discounting the operative risk and postoperative complications, a patient may be expected to regain a normal nutritional status following the removal of 33 per cent of the small intestine and that 50 per cent is given as the upper limit which may be borne with a possible satisfactory outcome. A greater loss than this is followed almost invariably by serious nutritional disturbances of varying degrees.

The exciting cause of volvulus in this instance was the presence of a mesenteric band acting as a central point of fixation around which the mesentery became twisted.

It can be safely assumed that preoperatively this patient had approximately 325 cm. of small intestine (considerably shorter than the average) exclusive of the duodenum and that postoperatively she has by actual measurement 90 cm. (Fig. 2) of small intestine which demonstrates that she has sustained a loss of 72.3 per cent of small intestine. Yet her present nutritional status compares quite favorably with that of any average normal adult as determined eighteen months postoperatively.

It is our opinion that the total length of jejunum and ileum combined were appreciably less than 90 cm. immediately postoperative. Yet one year after operation (Fig. 2) unquestionable dilatation and hypertrophy are evident, bearing out the observations of West et al.[4] This patient, too, has demonstrated her ability to assimilate carbohydrates well, proteins less well and fats poorly.

Individuals presenting extensive pathologic processes (ileitis, adhesions with obstructive symptoms) involving the small intestine might presumably survive extensive corrective resection today with our present postoperative supportive measures, which include adequate administration of protein, blood plasma and vitamins, than could be hoped for a few years ago.

SUMMARY

A patient requiring* massive resection (approximately 72 per cent) of the small intestine has been presented. At the present time this patient is enjoying normal health.

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* This patient moved to the Hawaiian Islands, married and became pregnant. According to a communication from her physician, Satoru Nishijima, M.D., her weight was well maintained during her pregnancy. I received a note from the patient stating that on March 25, 1947, she was delivered of a baby boy weighing 7 pounds and 4 ounces. She stated that the child was well developed. Her weight was being maintained and she was getting along very well. A recent communication dated December 29, 1948 from the patient's physician states that the patient's weight is 112¼ pounds. Laboratory examination shows red blood cells, 5,090,000, hemoglobin, 88.2 per cent; white blood cells, 9,350. Her general health is good. This represents her status four years postoperatively.

MALIGNANCY IN THE MALE BREAST

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GILBERT, in a recent article, gives credit to Gramiscus Arcaeus (1493–1573) and mentions several others antedating Thomas Barthomius to whom Warfield and numerous others have given credit for first mentioning cancer of the male breast. Fabricus Hildanus (1537–1619) described a single case of male breast cancer while Louis Heister, the famous German surgeon, described male mammary cancer at length in his inaugural dissertation. In the latter part of the nineteenth century the works of Horteloup and Poirier were the first to record systematic studies many investigators, such as Warfield who reviewed the known cases and added observations of his own. Recently Wainwright made an extensive review of the literature and added new material. He reported 418 cases with an examination of the pathologic material in 79.

It is generally known that carcinoma of the male breast is a rare occurrence but as Sarnoff points out despite the fact that it is more readily recognizable and is diagnosed earlier in the male because of the absence of surrounding fat and glandular tissue, once present it is more apt to recur in the male than in the female and has a higher mortality rate. He believes that the reason for this may be that there is less of a lymphatic barrier in the male as the distance is much shorter between the nipple and chest wall as well as the viscera. Sarnoff reported that for every cancer of the male breast there are one hundred cases of breast cancer in the female while Williams, in a series of 2,422 neoplasms of the breast, found 2,397 in women and 25 in men. These findings are further verified by a recent personal communication with John F. Erdmann who reports that among his series of 700 breast cases seven were in men, i.e., 1 per cent. In our own series of 706 malignant breast tumors five cases were carcinoma of the male breast, or 0.7 per cent. (Fig. 1.) At Memorial Hospital from 1918 to 1925 Coley reports 4,000 cases of malignant breast tumors of which only twenty-six were among men, twenty-five being carcinoma and one sarcoma.

A series of cases collected by Judd and Morse showed 1,751 cases in females and seventeen in males. It is interesting to point out that the United States census report of 1900 stated that the incidence of mammary carcinoma in the male was 0.7 per cent as compared to 15.7 per cent among females. The ratio of male breast carcinomas to all male cancers (Table 1) ranges from 0.38 to 1.5 per cent. The relative occurrence in the breasts of both males and females (Table 11) has been variously reported. Fitzwilliams says that in 296 recorded cases of carcinoma of the male breast 143 occurred on the left side and 148 on the right while in five the condition was bilateral. In the Judd and Morse series the left breast was affected in ten cases and the right in seven. The writer's case occurred on the left side.

It has been shown that mammary carcinoma occurs a few years later in the male than the female although Blodgett reported finding it in a boy twelve years of age and Bryan in one fourteen years and eight months. In Lunn's report the oldest patient was ninety-one years. In the cases of Judd and Morse the oldest patient was seventy-two and the youngest thirty-eight, the average age being 52.6 years. Eight of of the seventeen male patients were in the fifth decade. The writer's patient was sixty years of age. Wainwright reported an average of 52.6 years in the male and forty-five to forty-nine in the female. Sachs'

series revealed an average age in the male of 57.17 years, the youngest patient being twelve and the oldest eighty-six.

Carcinoma of the male breast was thought to be predominant in the white race because of reports from institutions in which the majority of patients were white. It has been reported, however, in almost all nationalities. Ludlow cited a case in Korea. Wainwright cited a case recorded by Sirrha in a native East Indian and one by Welch in Kiknyw of British East Africa. Moustardier described two cases in Madagascan natives. Many examples have been reported in negroes; Lewis and Reinhoff recorded three of 188 cases, and in Sachs' series of 205 cases 178 were in white patients, nine in negroes and one in a Chinese. The writer's patient was Italian.

A search of the literature reveals the variability in the known duration of malignant breast tumors before operation. A report by Owens and Eisendroth gives the history of a patient with a tumor of the breast for thirty-five years while Moore records the case of one who had a tumor for only two weeks. Judd and Morse cited a case of a patient with a history of a tumor for eighteen years although increase in size had occurred for only two years preceding operation.

The symptomatology of pain, bloody discharge from retraction of the nipple and ulceration vary with the type, situation and extent of the carcinoma. The variations are similar to those of carcinoma

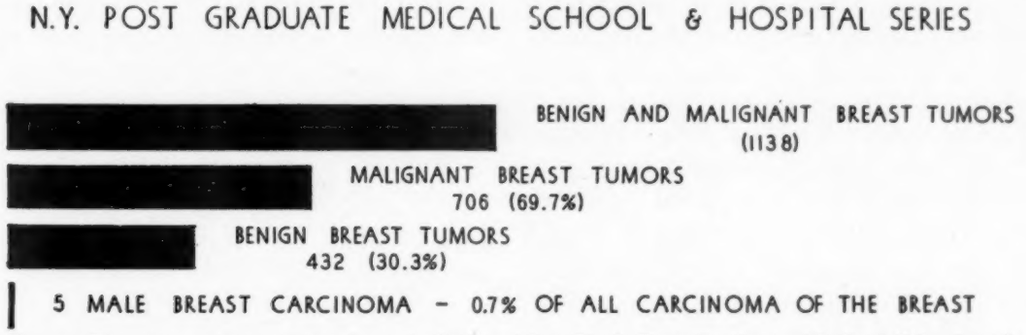
N.Y. POST GRADUATE MEDICAL SCHOOL & HOSPITAL SERIES
BENIGN AND MALIGNANT BREAST TUMORS (1138)
MALIGNANT BREAST TUMORS 706 (69.7%)
BENIGN BREAST TUMORS 432 (30.3%)
5 MALE BREAST CARCINOMA - 0.7% OF ALL CARCINOMA OF THE BREAST

FIG. 1. Breast tumors 1932 to 1941, inclusive; New York Post-Graduate Medical School and Hospital series.

TABLE I
INCIDENCE OF CARCINOMA OF THE BREAST IN THE MALE

Authors	In Relation to All Other Male Cancers (per cent)	In Relation to Female Breast Cancer (per cent)
Sachs' series (1940)	0.38	1.32
Williams (1889)	1.0	0.7
Peck and LeFevre (Gilbert, 1933)	0.41	1.25
Pondville Hospital (1940)	0.25	
U. S. census report (1900)—Moore	0.7	
Schreiner (1932)	1.25	
Deaver and MacFarland (1917)	1.5	
England and Wales Census (1926)—Gilbert	....	0.08
Schuchardt (1884)	....	2.0
Judd and Morse (1926)	....	0.9
Judd and Sistrunk (1914)	....	3.0
Rosh (1931)	....	2.0
Keyser (1904)	....	0.7
Yamamoto (1911)	....	1.08

TABLE II
SIDE INVOLVED IN CARCINOMA OF THE BREAST IN MALES AND FEMALES

Author	No. of Cases	Right Breast	Left Breast	Bilateral Involvement
Sachs' series (1940)	205	99	106	3
Cumston (1920)	266	139	126	1
Fitzwilliams (1924)	296	148	143	5
Wainwright (1927)	336	163	170	3
Gilbert (1933)	47	20	26	1
Lane-Claypon Females (1924)	13,909	6,907	7,002	
Lane-Claypon Females (1928)	1,767	809	958	

found elsewhere in the body. That ulceration in the male breast is more common than among females is readily understood when one considers the normal relative difference in the distance from the overlying skin in the two sexes. Cheatle and Cutler stated that ulceration is a common finding and Gilbert recorded the presence of ulceration and nipple retraction in 29 per cent of the subjects. Speed found nipple retraction in 50 per cent, Williams in 73 per cent. Gilbert stated that pain was present in 27 per cent of the patients. Judd and Morse attributed nipple retraction to the small amount of glandular tissue present in the male breast. Bleeding from the nipple was found to occur in 8 per cent of the cases according to Gilbert while Speed reported it in 50 per cent and Williams in 73 per cent. A review of single cases in the literature shows its presence in 24 per cent. There was no history of bleeding in the writer's patient.

There are several causative factors for carcinoma of the male breast to be considered. Trauma as an etiologic factor for this disease rests upon the history given by the patient. Gilbert states that fourteen, or 29 per cent, of the patients in his series had a previous history of injury while two patients were accustomed to exerting pressure against the chest wall in following their usual occupations. Ewing insists that a relationship between trauma and breast tumors may be assumed to have a causal significance only if the breast can be shown to have been previously normal and the injury to have been severe enough to have caused interstitial hemorrhage and solution of continuity of the breast duct; also that there must be some indication of continuity of symptoms between the trauma and the appearance of the tumor and that even in those cases one can only maintain a probable relationship. Knox also warns us that it would be as inaccurate and unscientific to ascribe the origin of cancer to a single blow as it would be to judge the duration of a tumor of the breast from the patient's statements.

Murphy, on the other hand, makes a radical statement that the breast is the only organ in the body where cancer will develop following a single mild trauma. Concerning the influence of trauma, reports in the literature vary greatly. Schuchardt considered 25 of his 219 cases to be due to contusions or mechanical causes. In only one of Judd's series of seventeen cases was trauma mentioned as a possible causative factor. Wainwright reports the relationship so frequently that he believes it must be taken into consideration as a cause of cancer, at least in the male breast. Breast carcinomas have been observed in shoemakers, carpenters and postmen.

It appears that heredity is of secondary importance as a causative factor in male breast cancer. Many explanations are given to account for the relative rarity of cancer of the male breast as compared with cancer of the female breast. Development of the gland is similar in both sexes until puberty. In the female the course is then one of great functional activity and cyclic changes whereas in the male the gland remains relatively stationery with less variation in the anatomic structure. The part endocrinology plays may also be a factor. However, this inherent difference in the functions of the gland is the most commonly accepted explanation. The rare occurrence of cancer of the male breast is in accord with the general rule that cancer seldom arises in vestigeal structures.

CASE REPORT

Mr. J. R., a sixty year old white man, was first seen by the author on October 15, 1941, complaining of a hard lump about 2 cm. in diameter in his left breast. He stated that this mass had been present for a period of two years and had not increased in size nor had it been painful at any time.

No discharge from the nipple area had ever been noted.

The past history revealed that as young man the patient often swapped chest punches with other young men. He also stated that about twenty-two years ago, while employed as a street car conductor, he was struck in the

left breast by the grab handle of a seat. Previous surgery included a left herniorrhaphy and hemorrhoidectomy about thirty-two years before and repair of a hydrocele thirteen years ago. The family history did not bring out any relevant facts and careful inquiry as to the possibility of familial cancer was negative.

Physical examination revealed a well nourished, well developed individual weighing 155 pounds. Examination of the right breast and axilla proved to be essentially negative. Palpation of the left breast revealed a rather firm, freely movable mass about 2 cm. in diameter in the nipple area. There was no discharge from the nipple area nor were there any signs of retraction. No palpable glands in the axilla were noted but there was slight swelling of the breast, with some tenderness and redness.

The tentative diagnosis was fibro-adenoma of the left breast. Approximately one week after examination the swelling, redness and tenderness practically disappeared. However, the firm mass previously described still remained. It was deemed necessary at this time to remove the mass and a simple excision was done through a thoracomammary incision at the lower angle of the breast which was about five inches in length. The mass was excised in its entirety; the nipple remained in place. Interrupted black silk sutures were used in the skin and one latex drain was inserted. The patient made an uneventful recovery. The pathologic diagnosis was medullary carcinoma of the left breast. In view of this diagnosis radical mastectomy became the procedure of choice. This was done about two weeks later after the patient, who was hesitant in consenting to further surgery, was made to realize the seriousness of his condition.

A radical mastectomy was performed on November 3, 1941. A Halsted-Willie Meyer incision was made through the skin and the superficial layers of fat. The skin edges were grasped with Kocher clamps. With Kocher clamps putting tension on the skin the knife was placed on the undersurface of the skin and dissection backward from the edge was begun, taking the subcutaneous fat off the underside of the skin flaps. Subcutaneous dissection was continued until the skin was elevated off the chest wall medially to the opposite border of the sternum, laterally to the lateral border of the scapula, inferiorly to the costal margin and superiorly to the clavicle.

Dissection of the chest wall was begun at the superior angle over the clavicular portion of the pectoralis major muscle and carried downward to the dividing line between the clavicular and sternal portions of that muscle. The pectoral muscle attached to the sternum was then cut away and all of the perforating vessels were ligated. The dissection was then carried laterally until the insertion of the pectoralis major muscle on the humerus was exposed. When this muscle was isolated, it was divided as close as possible to the humerus. The sternal portion of the pectoralis major muscle was then entirely freed from the chest wall and laid back to expose the pectoralis minor and axilla. The pectoralis minor was isolated and divided from the coracoid process. The cut ends of the distal portion were grasped with holding forceps and the muscle turned back over the clavicle.

The axillary dissection was started by dissecting the axillary contents away from the under surface of the clavicular portion of the pectoralis major at the insertion of the clavicle. This muscle was cleaned off by dissecting toward the operator. Over its outer surface the fascia (costoclavicular), which unites the outer edge of this muscle with its outer surface, was knicked with a knife all along the subclavius up to the first rib. This fascia was then divided in a horizontal fashion thus freeing it from the attachments to the chest wall. Upon completion of this a wiping outward and downward process exposed the vein and the plexus at the superior medial angle of the triangle.

The axilla was further exposed by a continuation of the wiping down process beginning well up underneath the clavicle, cephalad, to the vessels and plexus and directed downward at right angles to these structures. This was continued until the whole plexus was exposed. The dissection along the axillary vein was then begun and with a sharp curved clamp the sheath of the vein was penetrated at the point where the vein comes out from under the clavicle. The sheath was then split downward the whole length of the vein over the outer surface. The long thoracic artery was exposed, divided and ligated approximately 1 cm. from its origin from the axillary artery. The thoracodorsal nerve was preserved by isolating and ligating the artery and vein. The posterior axillary space was then cleared by lifting the

FIG. 2. Histologic appearance of breast tumor tissue in case reported showing medullary carcinoma.

vein, artery and plexus on a small retractor and by wiping downward and outward using gauze. All bleeding points were ligated with plain, single catgut.

The pathologic report following radical mastectomy was as follows: (1) chronic postoperative mastitis; (2) lymph node without secondary involvement; (3) medullary carcinoma. (Fig. 2.)

The patient's general condition was good on leaving the operating table. His pulse in the left wrist was of good quality and regular. After reacting from the anesthesia the patient was able to move his arm at the shoulder with some pain. During the course of his hospitalization motion in the shoulder joint was good and gradual movement was encouraged. The patient was discharged from the hospital after an uneventful recovery approximately ten days following operation.

He reported regularly for treatment and two months postoperatively, he weighed 155½ pounds and was doing his regular work as a gardener. The operative area was well healed with no evidence of recurrence and no axillary adenopathy. He complained of a "sticking pain" in the operative scar but despite that his physical condition was excellent. In October, 1942, his general and local conditions were satisfactory with no weight loss. A year later, in October, 1943, he entered the hospital for a left epididymectomy. No malignancy was found and he recovered successfully. Two months later an electrocardiogram, chest x-ray, blood and urine analyses were all normal.

COMMENTS

The successful restoration of this patient to normal health with normal function of the remaining parts is the most important and gratifying result of a complete and thorough radical breast operation. When last seen in the late spring of 1947, the patient showed no evidence of recurrence and his general health has been excellent. His appetite and digestion have been normal, with no weight loss. He has continued to work daily and motion in his left shoulder girdle is excellent. (Figs. 3 and 4.)

Although there were no axillary nodes palpable on preoperative examination, the breast was swollen, red and tender and in view of the pathologic diagnosis following simple excision, axillary dissection was thought advisable. Williams reports that axillary metastases are present in 63 per cent of the cases while Speed gives their incidence as 60 per cent, Joll as 60 per cent, and Wainwright as 68 per cent. Twenty-five per cent of the patients in Gilbert's series presented axillary nodes. In 48.3 per cent of Sachs' patients they were evident at the initial examination.

In regard to operability a review of seventy-five cases in the literature showed 58 per cent of the patients to be operable. Gilbert reported 58 per cent of his patients as operable and Bailey, 66 per cent. Sachs' reports show that at the time of examination 73.8 per cent of his patients were considered by the surgeons to be operable and 18.55 per cent inoperable; in 7.65 per cent no mention was made as to operability.

Male breast carcinomas are classified histologically in the same groups as carcinoma of the female breast, namely, adenocarcinoma, scirrhous carcinoma, medullary carcinoma and carcinoma simplex. Sarcoma, squamous cell and basal cell carcinoma are rare. Wainwright remarked that in his histologic studies he was unable to distinguish between male and female

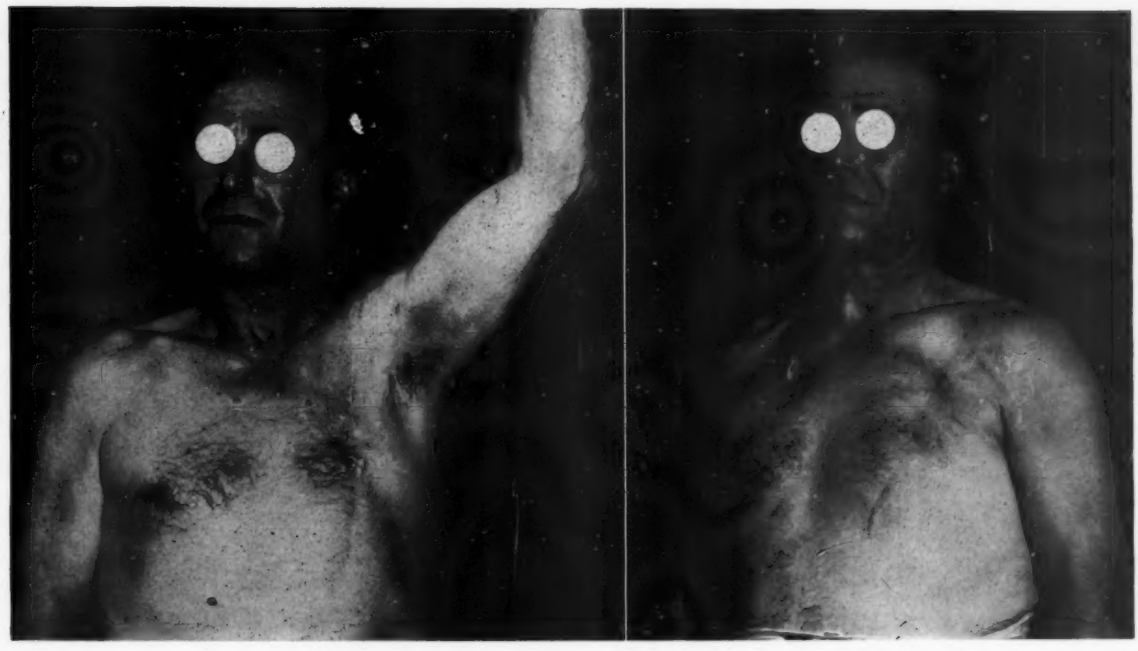

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FIG. 3. Patient, J. R., six years following radical dissection, demonstrating non-limitation of motion in the left upper extremity.
FIG. 4. Patient, J. R., six years postoperatively showing well healed mammary scar without recurrence.

breast carcinomas. Sachs reports in 178 cases the predominant pathologic finding was that of adenocarcinoma (40.7 per cent). Scirrhous carcinoma was present in 19.09 per cent, medullary in 9.55 per cent, simplex in 8.98 per cent, sarcoma in 2.24 per cent, squamous cell carcinoma in 0.56 per cent and Paget's disease of the nipple in 1.12 per cent. In Table III, Sach's pathologic findings are compared with those of Gilbert's and Wainwright's.

In a series of one hundred cases of adenocarcinoma of the breast Geschickter and Copeland reported only one case occurring in a male with generalized bone metastases. This is a rate metastatic site in the male breast. Gilbert reported that 40.4 per cent of his patients had local recurrences. Judd and Morse found the average duration before recurrence to be nineteen months whereas Williams claimed that in the male the average interval was 9.7 months and in the female twenty-six months. Local recurrences were present in 25.9 per cent of Sachs' patients. The majority took place within the first year although two patients had recurrences after fifteen years.

Clinical evidence of metastases was present in 46.3 per cent of Sachs' patients. In most instances the metastases were to the regional lymph nodes (twelve cases in the axilla, two in the supraclavicular fossa, two in the cervical region and two in the mediastinum). The brain, spinal cord and larynx were found to be involved, each in one case, while metastases to the lungs was demonstrated by x-ray examination in twenty-seven patients.

In 1892 Snow described specimens of bone in which the marrow reticulum had been replaced by a tough fibrous tissue which showed the characteristic acini of scirrhous carcinoma. Geschickter and Copeland described bone metastasis histologically as a destruction of the spongiosa and cortex by contact with tumor cells and to a lesser extent by activity of the osteoclasts absorbing spicules of dead bone. According to Geschickter and Copeland, extension is via the medullary cavity and haversian canals, beginning in the red marrow. The bones react to invasion by converting fibroblasts to osteoblasts, producing an osteoid tissue.

Paget stated that bone marrow hyperemia produces a slowing of the current within the dilated capillaries, thus favoring adherence of the tumor cells to the endothelium. Snow thought that cancer cells were in the general circulation and deposited themselves in the bone marrow. This may account for the anemia and cachexia in the late stages of the disease. Von Recklinghausen believed the marrow to be involved first by a hematogenous spread of the cortex through the nutrient foramen. Geschickter and Copeland explained the frequent involvement of the femoral head to be due to the blood vessels in the ligamentum teres. Handley favored a lymphatic permeation, but Neal and Oshers claimed that there are no lymph vessels in the bone.

TABLE III
PATHOLOGY IN CARCINOMA OF THE MALE BREAST

	Sachs' Series (178 cases) (per cent)	Wainwright (78 cases) (per cent)	Gilbert (47 cases) (per cent)
Adenocarcinoma	40.70	17.0	19.15
Scirrhous	19.09	49.0	4.25
Medullary	9.55	18.0	
Simplex	8.98	3.7	53.19
Carcinoma	15.73		
Gelatinous	0.56	3.7	
Squamous cell or basal cell	0.56	9.0	2.13
Paget's	1.12		
Carcinoma (Aspiration)	0.56	....	10.64
Sarcoma	2.24		
Premalignant Adenofibroma	1.12		
No record	.....	....	10.64

Although the incidence of carcinoma in the male breast is rare, particularly as compared with the occurrence in the female, it should be emphasized that a successful cure is dependent upon a thorough and meticulously performed radical operative procedure.

SUMMARY

1. A statistical study of carcinoma of the male breast, including incidence, age, race and the side involved, is presented.

2. The symptomatology and etiology with special emphasis on trauma is reviewed.

3. A complete case report of a male patient with a six-year cure following radical mastectomy for medullary carcinoma of the left breast is presented.

4. A survey of the literature is made in the discussion of pathology and the occurrence of metastases in the male breast.

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ADAIR and Munger studied the records of 110 patients with fat necrosis of the breast and found that in over one-half of the patients a history of trauma was not very definite. They also found that ecchymosis due to trauma had occurred in only twenty-one patients. The condition closely simulates malignancy since 65 per cent of these tumors were adherent to the skin and the nipple was retracted or elevated in fourteen cases. The authors found that almost one-third of these patients had enlarged axillary nodes which simulated the picture of malignancy even more closely. Surgeons should keep this condition in mind. (*Richard A. Leonardo, M.D.*)

HEMIPELVECTOMY IN TREATMENT OF OSTEOGENIC SARCOMA OF THE ILIUM *

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SINCE the original hemipelvectomy operation by Billroth in 1891[1] about 132 cases have been reported in the literature. In 1894 the first successful operation in which the patient survived the procedure was reported by Girard.[4] During the ensuing fifty-five years many terms have been used to describe the procedure, such as transiliac amputation, interilio-abdominal amputation or disarticulation, interpelvi-abdominal disarticulation, hindquarter amputation, transischiosacropubic disarticulation, interiliosacropubic disarticulation and innominate bone disarticulation.

Two primary factors must be taken into consideration in the evaluation of an operative procedure for malignant tumors, namely, the primary operative mortality and the long range end results as to cure or recovery. The disability resulting from such a procedure is considerable since the patient cannot be fitted with a prosthesis and must depend upon crutches for ambulation.

The operation and immediate postoperative mortality as reported by a survey made by Gordon-Taylor and Wiles[6] and Gordon-Taylor and Patey,[5] British surgeons, was 59.5 per cent in a series of seventy-nine cases. However, the overall mortality rate was about 36 per cent. In the past eleven years the mortality has dropped to 14 per cent.[13] In twenty-one personal cases reported by Gordon-Taylor[5] the operative mortality was 29 per cent and in his last ten cases the rate was 20 per cent. The major cause of death was shock at the time of operation or a few hours afterward. With a better knowledge of anatomy, anesthesia and methods of combating shock, the present operative mortality rate can be reduced.

Indications. Hemipelvectomy is indicated for primary malignant, osseous and periosteal tumors of the upper femur where the growth has extended to or through the hip joint and for similar tumors of the innominate bones. Large, primary malignant, soft tissue tumors of the upper thigh (involving the hip joint or extending through the obturator foramen), groin, buttock, pelvic parietes and iliac region are best treated by this type of amputation.[2,6–8,10–12]

Occasionally this radical procedure has been performed in the palliative therapy of cancer. In these cases, according to Pack, elimination of sepsis and pain and conversion of a foul-smelling, bed-ridden patient to comfort and partial activity can be accomplished in certain hopelessly advanced cases.[9]

Massive osteochondromas of the pelvis and massive plexiform neurofibromas involving the upper thigh, groin and hip joint or buttock and pelvic parietes are treated in this manner.[9,13]

It is important that an anatomic diagnosis be established by aspiration or open biopsy before radical amputation or any other form of therapy is instituted.

Preoperative Management. A complete survey is made to rule out any evidence of local pelvic parietes involvement or distant metastasis. This includes the necessary x-rays of other bones, lungs, intravenous pyelograms and barium enema, if necessary, and complete blood studies to

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include blood count, serum protein determination and non-protein nitrogen. Any changes that are not normal should be corrected by the necessary measures such as blood transfusion and parenteral administration of amino acids.

The insertion of a rectal tube and a Foley catheter prior to surgery will be a great aid in localization of these important structures during surgery. These also serve in the postoperative management of the case. It is suggested that in cases of large tumors of the ilium the introduction of a ureteral catheter on the side of involvement will facilitate the localization of the ureter during the procedure and aid in the prevention of injury or inadvertent division of the ureter. The anesthetic agent used by various authors is inhalation anesthesia, continuous spinal or spinal.[5,9,13,14] Arrangements for blood transfusions should be made and completed prior to surgery and it is recommended that a minimum of two, but preferably three, liters be on hand for immediate use.

Surgical Procedure. The management and institution of methods to combat shock is paramount. As indicated by Morton,[8] reduction in the incidence of shock can be expected in gentle handling of tissues and less harm by careful and deliberate dissection rather than by unnecessary speed and slashing of tissues. Several authors believe that frequent changes in position of the patient during the operation is a contributing factor toward shock.[3,6,9]

However, it is believed that shock is primarily caused by blood, blood plasma and tissue fluid losses; secondarily, by trauma, tissue manipulation, sectioning of large nerve trunks and sudden changes in position of the patient that are necessary to carry out this procedure.

It is important to have intravenous fluids started prior to incision. Shortly after the operation is started blood transfusion is begun. The anesthetist and surgeon should be certain that the veins being used for intravenous administration are adequate.

Position on the table is variable; some surgeons begin with the patient first flat on his back as was done in this case.[8,9] The anterior portion of the incision (Fig. 1A) extended from the symphysis pubis to the anterior superior iliac spine above and

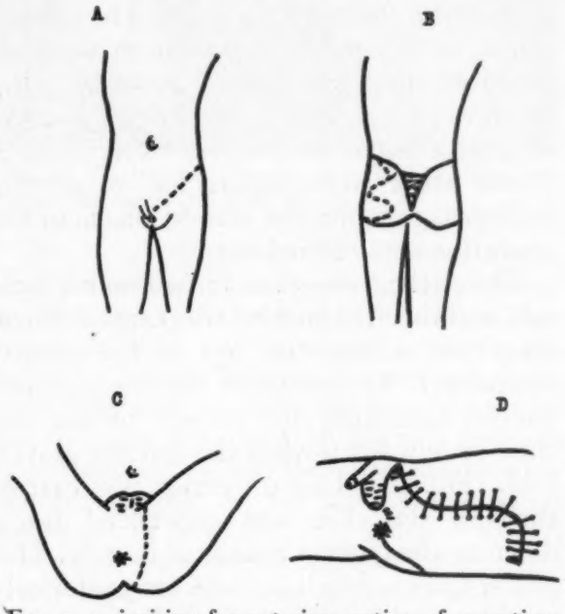


FIG. 1. A, incision for anterior portion of operation; B, incision for posterior portion of operation; C, incision for perineal portion of operation; D, wound closure with two drains.

parallel to the inguinal ligament and then along the medial border of the crest of the ilium to about the mid-point. This dissection was carried through the superficial fascia to the external oblique aponeurosis. The inguinal ligament was detached from the pubis and ilium and the rectus abdominis muscle was freed from the pubis. This frees all of the muscles of the anterior abdominal wall and permits extraperitoneal dissection. At this point the above flap was displaced upward and medially and the pelvic contents were then identified, such as the bladder, ureter, rectum and sigmoid. These structures and their peritoneal coverings were displaced and retracted medially and held out of the field by large packs and retractors.

The external iliac vessels were isolated and the artery was doubly ligated with chromic catgut and divided. The femoral

nerve was injected with 95 per cent alcohol and divided high in the iliacus muscle.

Dissection was continued, exposing the sacroiliac joint and the symphysis pubis was skeletonized. The symphysis was divided with the use of an osteotome, care being taken to prevent injury to the penis and urethra beneath the joint. The inferior ramus of the pubis and ischium were exposed at the "white line" at which point the levator ani, pelvic diaphragm and the obturator internus muscles were divided. These areas were packed off to control hemorrhage while the second phase of the operation was carried out.

The patient was then turned on his right side and the first incision was carried downward and across the top of the greater trochanter. At this point the incision was curved anteriorly for several inches and then downward toward the inferior gluteal fold. (Fig. 1B.) This dissection was carried through the skin and superficial fascia down to the gluteus maximus muscle. This posterior skin flap was dissected posteriorly to the sacral border on the left side.

The patient was returned to the original position on his back and dissection was continued anteriorly. The left lower extremity was elevated to drain out as much blood as possible before ligation of the external iliac vein was accomplished. The obturator artery and vein were doubly ligated and divided. The obturator nerve was injected and divided. After ligation of this vein the muscles of the anterior abdominal wall and the quadratus lumborum muscle were cut free from their attachment to the crest of the ilium. The iliopsoas muscle was divided high at the level of the lumbosacral crest. The sacro-iliac joint on the left was exposed and separated by the use of a chisel inserted by manual manipulation, pointing the blade obliquely lateralward. Considerable bleeding occurred at this point but was easily controlled by firm, warm packs for a few minutes. Anterior dissection now completed, the patient was turned on his right side again.

The posterior dissection was now continued, cutting the gluteus maximus muscle free from the posterior aspect of the sacrum. This muscle was not saved to be used as a flap for closure, as recommended by some authorities, because the tumor was invasive, involving the gluteus medius and minimus posteriorly and a portion of the obturator internus and pyriformis anteriorly.

The left half of the pelvis was free except for the attachment of the pyriformis, gemelli and levator ani muscles which were divided near the pectineal line. The sciatic tract was then injected and divided high up. The superior and inferior gluteal arteries and veins were ligated and divided.

The skin incision was carried from the inferior gluteal fold medially around to the perineum and then up anteriorly to join the starting point of the incision at the symphysis. (Fig. 1C.) The sacrotuberous and sacrospinous ligaments were divided and the entire left half of the pelvis and left lower extremity were freed and removed.

All bleeding points were controlled. Oxycel was placed over the raw surface of the sacroiliac joint and behind the symphysis pubis. The wound prior to this was irrigated thoroughly with saline solution; 10 Gm. of sulfanilamide powder were placed in the wound and the area was closed by mattress and interrupted sutures of chromic No. 1 catgut, bringing together portions of the iliopsoas and muscles of the anterior abdominal wall.

The quadratus lumborum muscle was sutured to the anterior groups of muscles. The remaining support to the pelvic content was obtained by suturing the subcutaneous tissues, the posterior flap to the same tissues of the anterior flap. Two long rubber drains were placed at opposite ends of the wound. The skin was closed by interrupted mattress dermal sutures. (Fig. 1D.) A snug bandage was applied.

Postoperative Management. The patient was placed in an oxygen tent for twenty-four hours. Intravenous fluids, including plasma, amigen and daily blood transfusions, were given for three days. On the

third postoperative day there was no distention and the patient was placed on surgical liquids; the diet was increased daily. The rectal tube was removed on the third day and the indwelling catheter was removed after four days but during this period tidal drainage was established and maintained. The patient had normal urinary control following removal of catheter and bowels were functioning without difficulty after the third day. The patient was given 50,000 units of penicillin every three hours for six days.

FIG. 2. X-ray taken January 30, 1947, showing extensive tumor of entire left ilium.

CASE REPORT

CASE 1. This patient, a twenty-two year old, white male, was admitted to the hospital for the first time on January 25, 1947. In September, 1945, while returning home from overseas, he noticed pain in his left hip with radiation of the same along the inner aspect of the thigh as far as the knee. He was discharged from the service on January 6, 1946. Following his discharge the pain became progressively worse, being more severe at night. The pain was exaggerated on coughing or sneezing and was intense enough to cause limping when walking. During this period of time he was seen by several physicians and on August 16, 1946, was seen in one of the clinics at which time he complained of low back pain. Physical examination at that time was negative and an x-ray of his lumbosacral region was reported negative.

On October 29, 1946, he returned to the same clinic with complaints of left sciatica of four days' duration and pain on motion of the left hip. Recheck x-rays taken at this time revealed a tumor of the left ilium involving the supra-acetabular region with extension toward the sciatic notch. The tumor showed evidence of both an osteoplastic and osteolytic process.

On October 31, 1946, an open biopsy was taken from the mass of the left ilium. The microscopic report at that time was an osteogenic sarcoma. He was given a course of x-ray therapy from November 8, 1946 to January 24, 1947; a total of 3,528 roentgen units anteriorly, posteriorly and laterally of the left ilium. The other x-rays and examinations revealed no evidence of local or distant metastasis prior to admission here.

The patient was then referred to this hospital for further examination and treatment. At the time of his admission he stated that the pains were not as severe as they were before irradiation therapy. He noticed weakness of the muscles of the left lower extremity and had pain on walking. He lost only 4 pounds since the onset of his illness. He had no complaints referable to the gastrointestinal or genitourinary tracts.

Physical examination was essentially negative except for the area of the lateral wing of the left ilium. This area was fuller and firmer than the opposite side and there was limitation of motion of the left hip joint. Motion of the extremity produced pain. Abdominal palpation medial to the left iliac crest gave a sense of fullness in the pelvis in the left iliac fossa. On rectal examination there was a sense of fullness and firmness on the left near the ischial spine. There was no evidence of local lymph node involvement or local extension to the rectum or bladder.

Stereoscopic x-rays of the pelvis on January 30, 1947 (Fig. 2), revealed an osteoplastic and osteolytic process involving the posterior aspect of the left ilium extending downward toward the obturator foramen with growth occurring inward toward the pelvis. There appeared to be no soft tissue involvement in these areas. X-rays of the chest, lungs and spine were negative.

Laboratory data on January 29, 1947, were as follows: red blood cells, 4,940,000; hemoglobin, 14.5 Gm.; white blood cells, 6,900; polymorphonuclears, 68 per cent. Three days following surgery, February 23, 1947, laboratory data were: red blood cells, 4,260,000; hemoglobin, 12.5 Gm.; white blood cells, 4,100;

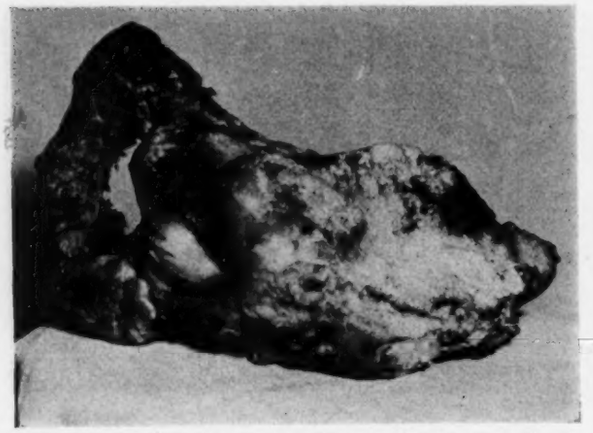


FIG. 3. Gross specimen of entire left innominate bone, external view; extensive tumor formation.

non-protein nitrogen, 48; total proteins, 6; blood chlorides, 480. On February 6, 1947, blood calcium was 8.7 and alkaline phosphatase was 7 Bodansky units. Urinalysis was normal and blood serology, negative.

On February 20, 1947, a left hemipelvectomy was performed under general intratracheal anesthesia. The patient received 6 pints of whole blood during the operative procedure and 1 pint following surgery. The lesion had not extended to involve the urinary tract or any of the pelvic parietes.

Postoperative intravenous pyelograms revealed normal function from both kidneys and no obstruction or distortion of the left ureter was seen. Postoperative x-rays of the pelvis revealed a complete removal of the left innominate bone from the symphysis pubis back through the left sacro-iliac joint. The soft tissue of the stump area revealed no evidence of tumor mass.

Examination of the gross specimen (Fig. 3) obtained after disarticulation revealed the muscles surrounding the wing of the ilium to be pale in color, edematous and to contain gritty, hard, direct extensions of the neoplastic mass involving the ilium.

The main tumor mass involved the entire wing of the ilium and was expansive. It measured 13 cm. in diameter. It did not appear to involve the ischium or the ramus of the os pubis. The greatest expansion of the mass was externally on the wing and here was a large, dome-shaped mass measuring 12 by 15 cm. The cortex covering this mass was paper thin.

There was another rather soft mass in the region of the sciatic notch which bulged internally and measured approximately 2 by

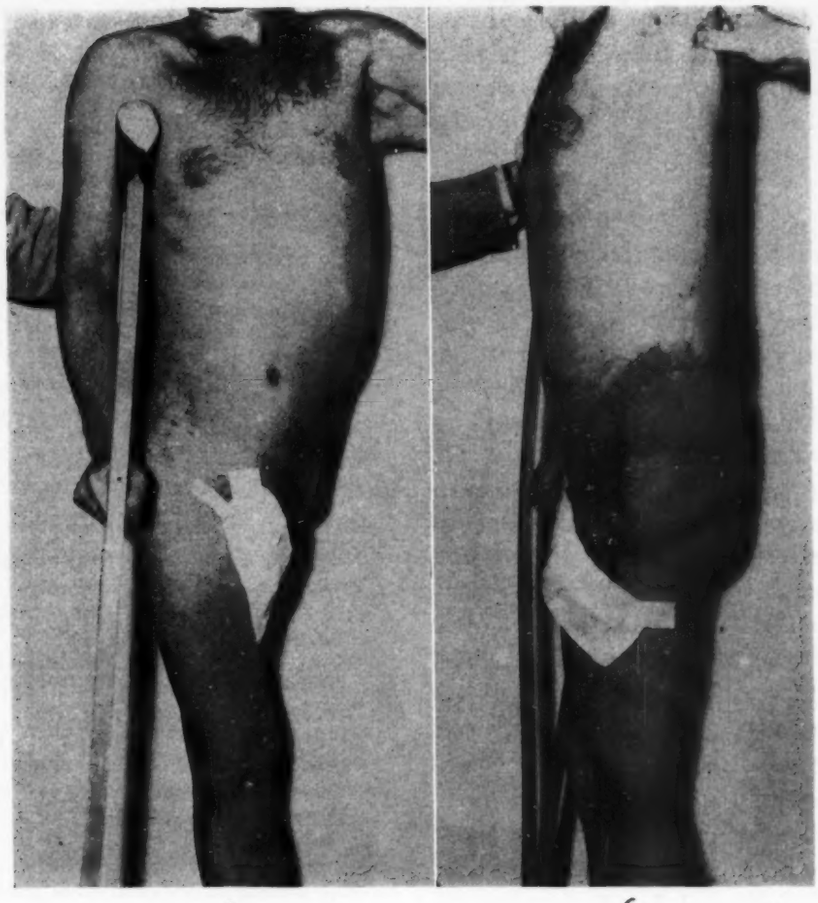
FIG. 4. Microphotograph of tumor of ilium.

1.5 cm. On cross section there were large, clear, cartilaginous foci measuring up to 4 mm. in diameter; cystic spaces, some of which were filled with blood; areas of softening and necrosis; and an irregular network of bone spicules.

Microscopically, examination (Fig. 4) of the sections presented an extremely diverse histologic pattern. Portions were seen in which irregular, poorly formed spicules of bone were being laid down by extremely active osteoblasts. In these areas osteoblastic activity was marked. The stroma in these areas appeared rather myxomatous.

In other areas there was a large, extremely cellular mass of wildly growing, deeply stained hyperchromatic cells arranged in no specific pattern. Individual cells were very large and irregular and possessed a large amount of basophilic cytoplasm. Nuclei varied markedly in size, shape and staining capacity. Most of them were huge, oval to round and contained two or more nucleoli. Areas of hemorrhage were seen as were tumor cells which were seen free within the vascular lumina. The pathologic diagnosis was osteogenic sarcoma.

The drainage from the wound was serosanguineous in character and was moderate in amount during the first five days. The drains were removed at the end of six days



5 6

FIGS. 5 and 6. Patient on the sixteenth postoperative day.

and the wound healed by primary intention except for drainage at both ends. The patient was ambulated on the tenth postoperative day. His activities gradually have been increased. (Figs. 5 and 6.) There was no evidence of necrosis of the skin flaps. The wound area was supported by an Ace bandage dressing.

At the present time (June, 1947) there is no evidence of local residual tumor or demonstrable distant metastasis.

COMMENTS

The end results of this procedure will be improved when surgeons acquaint themselves with the fact that the operation can be undertaken with relative safety and that operative mortality is now 14 per cent.[5,9,13]

This figure can be lowered by the institution of good preoperative, operative and postoperative methods to combat shock. A complete knowledge of the anatomy involved coupled with good basic surgical principles will carry the well grounded surgeon through such a procedure. In this way more patients will be offered a chance for cure, especially in certain types of malignancies which they are now denied by conservative measures.

Benign tumors such as neurofibromas, benign giant cell tumors, giant osteochondromas and chondromas offer the best prognosis. The chondrosarcomas[9,13] offer the most favorable prognosis for the malignant bone tumors. Less favorable in prognosis are the well differentiated soft tissue sarcomas.[9,13,6]

Osteolytic osteogenic sarcomas and very undifferentiated soft tissue sarcomas should have the benefit of this operation although the possible cures are lowest among the entire group.[6,9,13]

Ewing's sarcomas, plasma cell myelomas and metastatic tumors should not be subjected to this operation except under unusual circumstances.[9,13]

SUMMARY

Since the first successful operation by Girard fifty-three years ago 132 cases have been reported. A mortality rate of 60 per cent was reported in the first seventy-nine cases. In the past eleven years operative mortality has dropped to 14 per cent. The overall mortality was 36 per cent.

This drop in mortality has been due to the development of methods of combating shock and hemorrhage. The present mortality rate can be expected to drop still lower by a better understanding of the anatomy involved, technics developed and the institution of active steps to prevent shock by free use of whole blood and plasma transfusions.

Follow-up statistics have been unsatisfactory to date. However, of the forty-five patients who survived the operation and who were followed for five or more years, twenty-one remained clinically well; twenty-four died of their disease.

Radical amputation seems to be a definite and distinct advancement in the radical treatment of selected cases of malignant tumors of the lower extremity, buttock, groin, innominate bone or pelvic parietes and by careful consideration of these factors in the future, prognosis of such lesions can be favorably influenced.

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TWISTED HEMATOSALPINX*

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THE term hematosalpinx was long understood to designate any tube filled with blood. Then Veit came forward with the suggestion that tubal pregnancies as well as blood tubes due to new growth should be excluded, a view which is now generally accepted. Thus hematosalpinx may be divided into the following three groups according to origin: (1) cases in which the condition is due to a congenital obstruction of the genital canal (gynatresia); (2) cases attributable to bleeding from a ruptured blood vessel into a previously occluded tube (as in salpingitis, hemorrhagic inflammation, typhoid fever or phosphorus poisoning); and (3) cases attributable to a severe disturbance in blood supply due to torsion or twisting of the tube, either normal or diseased. Heynemann is of the opinion that torsion of the normal tube is not too "uncommon" and stresses the importance of keeping this possibility in mind. In 1918 Schweitzer published a case presenting isolated torsion of a normal tube; similar cases have been described by Michael, Hansen, Scheid and Neugebauer.

The literature contains similar reports by Rueder, Aulhorn, Norris, Roger, Stark, Herff, Hirst, Barton and Branch, Neel, Lear and Virnig, Auvray, Ansbach-Prager, Eunike and others as well as reports on cases involving complete amputation of the twisted tube by such authorities as Kolb, Ruppold, Ries (bilateral), Barrett-Lash and Anderson. In 1927 before the Obstetrical Society of Vienna the writer presented a case of a twisted tube in pregnancy. Many a case of this kind is probably overlooked for the reason that diagnosis is often difficult. The writer believes, therefore, that it might be useful to describe the condition in some detail and to submit a report on a recent, particularly illuminating case.

Etiology. The literature mentions the various factors generally held responsible for torsion of a tube. As a rule, however, no clear distinction is made between the general condition, the immediate cause and the twisting forces themselves. It would seem timely, therefore, to attempt to clarify this question of the etiology of torsion and above all to establish the difference between predisposing factors and twisting forces.

The predisposing factors may be divided into two categories: (1) those directly related to pathologic conditions generally in the abdomen (e.g., adhesion, displacement of organs); and (2) those directly related to the part which is twisted.

Moreover, the twisting forces themselves can operate in two distinct ways: (1) from without (e.g., a blow on the abdomen or some extraordinary movement of the body as in sports, or dancing) with repercussions in the part in question; and (2) from within the abdomen (e.g., a growing tumor or intestinal peristalsis).

In each case the predisposing factors and twisting forces should be studied separately. The following, which lists the factors and circumstances likely to favor torsion, is designed to facilitate determination of the etiology in a given case by making it somewhat easier to recognize both the predisposing factors and the twisting forces at play.

PREDISPOSING FACTORS

1. Pathologic condition of the tube itself:
   (A) Enlargement and elongation (Rokitansky, Anspach)
   Congenital
   Infantilism (Schweitzer)
   Acquired
   Hydrosalpinx

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Hematosalpinx
Pyosalpinx
Ectopic pregnancy
(B) Abnormal mobility due to long and membranaceous mesosalpinx
Congenital (Michel, Roger, Davies, Barrett)
Acquired
Pregnancy (Aulhorn, Tauber)
Ovarian or parovarian tumor (Tauber)
2. Pathologic conditions elsewhere in the abdomen:
(A) Adhesions (Rokitansky)
due to previous operations or acute or chronic inflammations
(B) Displacement of the uterus causing narrowing of the pedicle (Barrett)
(C) Tumor formation

TWISTING FORCES

1. Extraperitoneal forces (Sellheim, Hansen, Rieder)
(A) Trauma
Fall; blow to the abdomen
(B) Active movement of the whole body
(a) Sudden or constant movements
(b) Continuous or repeatedly equal movements
(C) Increased action of the abdominal pressure
(a) by lifting heavy weights
(b) on coughing
2. Intraperitoneal forces
Traction of shrinking adhesions
Traction or pressure
of adjacent neoplasms (Tauber)
of growing pregnant uterus (Barrett, Tauber)
of displaced organs
Irregular growing of the organ itself which influences its balance (Schweitzer, Payr)
Resistance in growing to a certain direction by the presence of vessels, ligaments, etc.
Intestinal peristalsis (Schweitzer)
Tubal peristalsis
Alternate distension and evacuation of the bladder
Increasing of the abdominal pressure by straining
Hemodynamic mechanism (Payr), activated by:
Menstruation (Michel, Norris, Roger, Schweitzer)
Constipation (Stark, Schweitzer)
Coitus (Schweitzer)
Prolapsing uterus (Barrett-Lash)
Adhesion (present case)

Opinions on the twisting forces are sharply divided. Sellheim stresses the extraperitoneal forces and believes that most cases are due to these forces alone. On the other hand, Payr's interesting theory of hemodynamic torsion is completely different. After extensive studies on models and cadavers he was the first to induce intra-abdominal torsion of the pedicle of artificial tumors in the omentum of animals. He arrived at the following conclusion:

Arteries have a firm and rigid wall and act as a support for the pedicle. The veins are much longer and often tortuous. The elasticity of their walls allows an enormous increase in their capacity. Compression or kinking of the pedicle activates this development. The thin-walled veins are far more prone to obstruction than the more resistant arteries. The veins receive blood from the capillaries without resistance. In this way the veins are congested and increase in length as well as in transverse diameter and ultimately form a concave bow toward the artery. The connective tissue between the artery and the vein, however, limits the bow formation and forces the vein to form a spiral around the artery. This leads to torsion of the pedicle. Torsion brought about by unequal pressures in the blood vessels of the pedicle is termed hemodynamic torsion.

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

Diagnosis of a twisted tube is always a difficult matter. The clinical picture is not sufficiently characteristic; as a rule, therefore, the true nature of the condition is not discovered until the patient is being operated on, generally under the diagnosis of acute appendicitis. The twisted tube must be differentiated from ureter stone, ectopic pregnancy, acute appendicitis and salpingitis.

Both a ureter stone and a twisted tube are associated with repeated attacks of severe pain radiating to the back and to the symphysis. Urologic studies and x-ray examination will generally serve to exclude a ureter stone.

In the differentiation of a twisted tube from an ectopic pregnancy the vaginal examination is of little help. The adnexal mass cannot be outlined definitely because of the patient's inability to relax due to severe pain. The absence of fluid in the cul-de-sac of Douglas does not exclude ectopic pregnancy and the presence of fluid might be interpreted as an exudate or evaded blood from a twisted tube. Small amounts of fluid without bulging of the

posterior vaginal wall can hardly serve as a basis for the diagnosis. The red blood count is of no diagnostic value because it can be normal or subnormal in both conditions. Only the history remains; this may be very characteristic of ectopic pregnancy although in rare occasions ectopic pregnancies are encountered in the presence of normal menstruation.

Both acute appendicitis and a right twisted tube show severe pain in the right lower abdomen. The pain in appendicitis may be somewhat higher up but this finding is too vague to serve as the basis for a differential diagnosis. The difficulty is further increased by the fact that the blood count shows a high increase in the number of white blood cells and a high percentage of polymorphonuclear leukocytes in appendicitis as well as in cases of a twisted tube because of the peritoneal irritation. A history of vomiting in both conditions is another symptom likely to lead to the wrong diagnosis. The discovery of a soft, longitudinal mass on the side of the uterus, by vaginal examination after administration of a sedative or in anesthesia, will exclude appendicitis or at least suggest that appendicitis is most unlikely.

Acute salpingitis can be excluded safely by the absence of high temperature. Moreover, salpingitis is generally bilateral and commonly presents other signs of acute inflammation on the external genitalia, such as vulvovaginitis, urethritis, infection of Bartholin's glands and purulent discharge.

CASE REPORT

J. G., a twenty-eight year old woman, was admitted to the Graduate Hospital on December 23, 1946. She complained of severe pain in the right lower abdomen and was unable to walk in an upright position. She had one six year old child, with no miscarriages. Menstruation began at the age of fifteen, was regular every twenty-eight days lasting 5 to 6 days, was moderate in quantity and was associated with slight cramps on the first day. The last menstruation, which was of normal duration and quantity, was on December 9, 1946. The patient had undergone a left salpingo-oophorectomy, February 17, 1942, because of an ectopic pregnancy.

For the past two years the patient complained of pain in the right side of the abdomen and the back all the way down to the inguinal region. The pain came in attacks, the first of which made its appearance two years previously. An x-ray examination was done in another hospital where she was informed that she had a ureter stone. She said that the stone dissolved after she took medicine. For the past year she was treated every month by dilatation of the ureter. There was a second major attack on Easter, 1946. Again she was hospitalized and treated by ureter dilatation. In November, 1946, a third attack brought her back to the same hospital where x-ray studies and dilatation of the ureter were carried out. The patient was in permanent pain ever since and was unable to walk or stand upright. On December 17, 1946, a fourth attack led to hospitalization. X-ray studies and urologic examination were completely negative. The patient was discharged from the hospital but was never free of dull pain in the abdomen. On December 22, 1946, she suffered an attack of severe pain accompanied by vomiting. Her family physician sent her to the Graduate Hospital.

On admission the patient's temperature was 100.1°F. and her pulse, 92. The right lower abdomen was so extremely tender that she could not tolerate the slightest touch. After administration of a sedative a careful vaginal examination was performed. The following findings were noted: uterus of normal size, in body axis, firm and of limited mobility; the right adnexal area was extremely tender; a soft mass between the right uterine edge and the symphysis could be palpated but it was impossible to outline the mass definitely because of the pain and the patient's resistance.

The chart of the previous operation bore the information that a left salpingo-oophorectomy had been done because of an ectopic pregnancy, the latter having been determined by the microscopic finding of large cells and syncytial masses in the fallopian tube.

No diagnosis could be given after the first examination after admission. Ectopic pregnancy on the right side, a ureter stone, appendicitis and acute salpingitis were under discussion. The family physician informed us that a urologic examination, including an x-ray study performed a few days previously in another

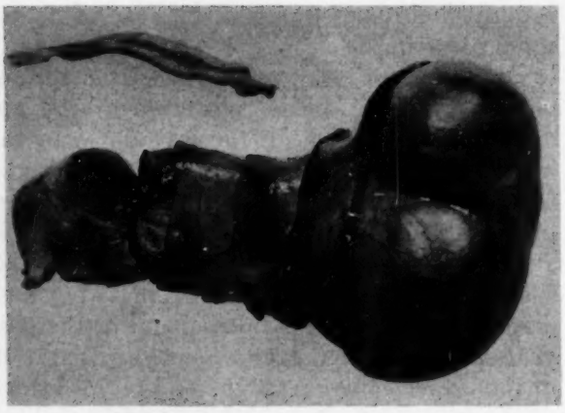

FIG. 1. Specimen of the removed right hematosalpinx and the band-like adhesion which extended across the pelvis. After fixation the specimen was cut in several segments to allow histologic studies in order to exclude inflammation and ectopic pregnancy.

hospital, had been completely negative. On the strength of this information the diagnosis of a ureter stone was excluded. Ectopic pregnancy seemed most unlikely in view of the history of perfectly normal menstruation. The temperature of 100.1°F. did not suggest an acute process in the appendix or the adnexal area.

The blood count revealed the following: erythrocytes, 4,400,000; hemoglobin, 75 per cent (12.5 Gm.); leukocytes, 13,900; neutrophiles, 88 per cent; lymphocytes, 10 per cent; and mononuclears, 2 per cent. The blood count pointed to acute appendicitis but the vaginal findings suggested an adnexal disease. The fact that the temperature was only slightly elevated together with the comparatively low pulse certainly seemed to exclude any acute inflammation. Therefore, while no definite diagnosis had been made, we decided to resort to surgery in the expectation of finding some pathologic condition in the adnexal area.

The abdomen was opened by midline incision. On the right side there was a bluish-black adnexal mass the size of a lemon which proved to be the enlarged right tube. The mass was caught by a band-shaped adhesion some 7 cm. in length which extended across the inlet of the pelvis from the top of the bladder to the sigmoid and which probably had been caused by the previous operation. The tubal mass was twisted, making four times a complete turn of 360 degrees. The ovary was abnormally far from the tube. There was no free blood in the abdominal cavity. Salpingectomy was performed and the band-shaped adhesion was removed. The cecum was inspected but no appendix could be detected. The appendix probably had been removed in the course of the first operation but no mention of the fact appeared on the chart.

The postoperative course was uneventful and the patient left the hospital on the tenth day after surgery. She had no complaints and said she felt perfectly well.

Pathologically, the fallopian tube was a bluish-black, retort-shaped, twisted mass showing acute circulatory changes. (Fig. 1.) The length of the tube was 10 cm. and its greatest diameter was 4.5 cm. The peritoneal surface was smooth and the mass was semi-solid. The uterine end was conical and the two loops formed by the torsion were glued together. The fimbriotic end was closed. Only a few small residua of the fimbriae were present. Section of the tube revealed a thick, dark red wall. The lumen was filled with clotted blood and bloody fluid; longitudinal folds were visible after removal of the contents.

Histologically, the muscle fibers of the tubal wall were separated by masses of red blood cells and by edema. The vessels were markedly dilated. There was extensive thrombosis of the veins. The endosalpinx was infiltrated with blood; the epithelium was flattened and lifted away from the underlying layers in some areas. At a few points there was no trace of epithelial tissue. The wall contained many cells filled with blood pigment. No evidence of inflammation and ectopic pregnancy could be found.

The pathologic disturbance in this patient was an originally normal right tube which had undergone acute axial torsion resulting in strangulation with consequent hemorrhagic changes. The rapid development of the edema together with the thrombosis of the veins gave the pedicle a plastic consistency which made detorsion and restitution impossible.

COMMENTS

This case is especially illuminating from the diagnostic viewpoint. Even a previous appendectomy did not prevent the usual error of taking appendicitis into serious consideration. The patient did not know that the appendix was out and, as mentioned, the appendectomy was not recorded on the old chart. The possibility of a ureter stone could be excluded here in view of the

complete urologic examination performed in another hospital only a few days before admission. However, it is amazing to note that this patient was treated repeatedly in the same hospital for a stricture of the right ureter and for a ureter stone two years previously. She had never seen the stone nor had its presence ever been demonstrated by x-ray. It is highly probable, therefore, that the various attacks which led to the repeated hospital visits were due to torsion of the tube and that the attacks of pain were due to the pathological condition of the tube rather than to some dubious ureter stone. This, however, can be considered proved beyond doubt only if the attacks do not recur in the future.

Ectopic pregnancy was not definitely excluded but seemed most unlikely in view of the history of perfectly normal menstruation. The patient reported no irregularity; both the duration and the amount were normal and constant as far as could be ascertained. However, the history of a previous ectopic pregnancy on the left side did arouse the suspicion that the case might possibly be one of ectopic pregnancy on the right side.

The difficulties involved in making the diagnosis of a twisted tube underscore the importance of considering the possibility of acute salpingitis as well as of a twisted tube in any case of questionable appendicitis in a female patient. Attacks of pain always point to the diagnosis of twisted pedicle. This symptom, which is generally recognized as pathognomonic in ovarian cysts, is often neglected in the diagnosis of a twisted tube so long as there is no ovarian pathology. However, the history of repeated attacks of pain seems to be more significant diagnostically than all the other symptoms and constant awareness of this fact will prevent many errors and enhance the chances of a correct diagnosis of twisted tube before the abdomen is opened.

As for the etiology of the case under discussion, inspection of the tables will show that there were predisposing factors here directly related to pathologic conditions in the tube itself as well as elsewhere in the abdomen. There was a firm adhesion across the pelvis due to the previous operation. The ovary was abnormally far from the tube, showing that the right mesosalpinx was extremely long, forming a pedicle which was well predisposed for torsion. The tube itself was abnormally long, probably a congenital condition. It seems very likely that there was also an elongation of the other tube and that this brought on the ectopic pregnancy which was operated upon two years ago.

The patient gave no history of trauma. There was no recollection of any fall or blow to the abdomen which could be construed as an extraperitoneal twisting force but, of course, active and extraordinary movements of the whole body and increased abdominal pressure can never be excluded completely.

In this case the intraperitoneal forces and, most particularly, the factor of tubal peristalsis seem to be of greater importance. It requires no stretch of the imagination to picture the probable sequence of events here. Since the long tube on the elongated mesosalpinx had an exceptionally wide range, the tube was caught in the band-shaped adhesion across the pelvis; the band exerted pressure on the tube, blocking the circulation and thus activating the twisting forces for hemodynamic torsion. Torsion, in turn, brought on the pathologic changes. It may be presumed that these changes took the following course: the peritoneal layers of the tube were glued together; congestion increased more and more; the mucous membrane became edematous; and blood evaded into the lumen; the fimbriatic end was inverted as a result of the extremely swollen condition of the mucosa (a mechanism described by Opitz); the tube, finally, closed up and the collection of blood in the tube formed the hematosalpinx. In this case, therefore, it would seem that a previously normal tube had been twisted and that the hematosalpinx subsequently developed. The hematosalpinx became another predisposing

factor favoring the subsequent torsions. The twisting forces of the later torsions were probably a combination of the hemodynamic mechanism and extra- and other intraperitoneal forces.

SUMMARY

A brief review of selected cases of twisted tube was followed by a few words concerning the significance of this condition. An attempt was made to dispel some of the confusion surrounding the etiologic problems by drawing a sharp distinction between the predisposing factors and the twisting forces. Tables listing such factors and forces were submitted in the hope that this condensed information might facilitate determination of the etiology in a given case. The difficulties involved in making the diagnosis were pointed out and some directions were given as to the manner of differentiating between this condition and other entities presenting similar symptoms. An enlightening case observed by the writer was reported in detail notably for the purpose of illustrating the difficulty in establishing the differential diagnosis. The pathology and the development of the pathologic changes in the normal tube were discussed.

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PLANTAR FIXATION SIGN

DIAGNOSTIC AID IN ACUTE ARTERIAL INTERRUPTION OF THE LOWER EXTREMITY

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THE purpose of this communication is to describe a physical sign which, when applied to acute interruptions of the main artery of the lower extremity, may prove useful in differentiating these lesions from other conditions which at times closely simulate them. Cases quoted herewith represent trauma seen in a theatre of war but there are reasons to believe that similar interruptions in civil practice could also be attended by the same sign, making this diagnostic addition no less useful in the latter type of practice.

Having been assigned to the attendance of vascular injuries in an evacuation hospital, it was soon observed that complete interruption of the main stem artery of the lower extremity produced in as little as *five hours* a degree of muscular (fibril) swelling which, although not appreciably increasing the diameter of the affected calf, so interfered with the passive stretching of the muscles as to render the foot incapable of dorsiflexion beyond a right angle. When unsuspected or unproved interruption of the main stem artery was present and the patient was in such a state of shock that there was no pulse in either foot, or when a moderately shocked patient had been exposed to cold so that both extremities were of nearly equal temperature, the sign then became useful as an added indication of a condition frequently undiagnosed in forward stations (and occasionally in the shock ward of this field type hospital) before the patient had been resuscitated sufficiently from shock to restore pulse, color and differentiation of temperature when comparing the two extremities or, obviously, before gangrene was clinically evident.

The performance of this test is essentially the same as that producing Homan's sign but is an objective test and does not depend on patient participation, namely, complaint of pain. Furthermore, in the type of patients referred to in this communication pain was frequently due to accompanying injuries in other portions of the extremity (or the same portion, in fact) and derived from the motion of fractures multiple soft tissue injuries and so forth.

A limitation of passive dorsiflexion of the foot, except for such obvious reasons as fracture in the region of the ankle, was never observed in these badly injured extremities except when vascular interruption was later demonstrated. Also, the sensation of a markedly edematous muscle which has reached its maximum passive extension is quite different from that of a spastic muscle which still retains good tone. The sensation is similar to that which would be expected if the lever (foot) were attached to a rope, or nearly so, depending on the stage of advancement of the effects secondary to complete ischemia. (Fig. 1.)

The cases reported herein were selected to illustrate this sign.

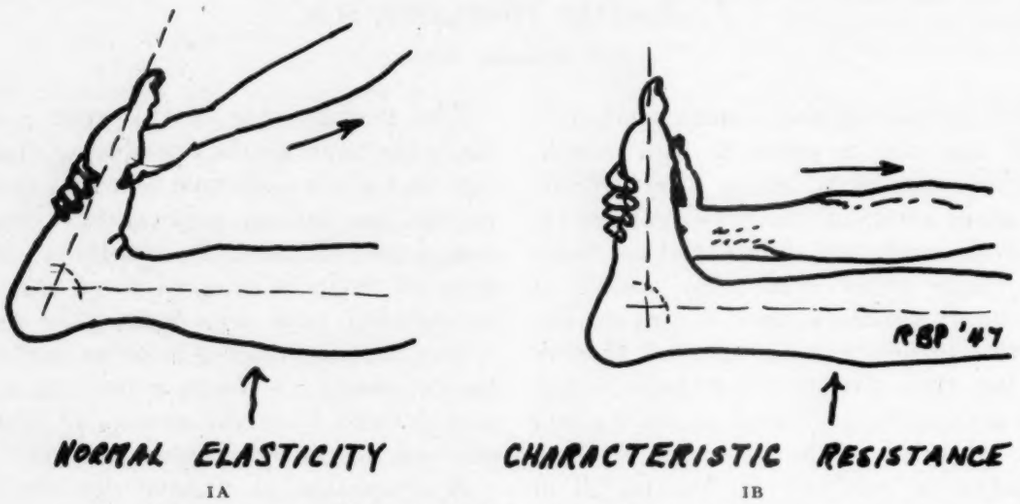
CASE REPORTS

CASE 1. L. H., an infantry private, twenty-four years of age, was admitted with a perforating wound of the left thigh, femoral triangle region. When first seen he had no pulse in either foot and his blood pressure was 80/40. He had had 1 unit, 250 cc. of plasma in a forward station. On admission his feet were approximately of equal temperature, namely, warm but the left foot could not be dorsiflexed beyond a 90 degree angle, whereas the right could be and the sensations at the limits of dorsiflexion were different on the two

sides as heretofore described. The patient was given 2 units of blood and when he was in a condition more appropriate for operation, it was demonstrated that the femoral artery had been completely transected and closed by thrombus near the middle of the femoral

the patient did not react from anesthesia for six hours. Because of the poor response to the laparotomy, nothing was done for the other injuries at the first stage.

Immediately on reaction from anesthesia the patient complained of pain in the left leg.



1A 1B

FIG. 1. A, normal flexes 75 (±5)°; B, plantar fixation +90° or more.

triangle and that the profunda artery was intact but so spastic as to have a negligible pulsation. The wound was débrided, the femoral artery and vein were ligated and periarterial stripping up to the inguinal ligament was performed. By the sixth postoperative day the patient had demarcating gangrene up to the ankle.

CASE II. G. G., a twenty-one year old staff sergeant, was admitted with a history of having sustained multiple shell fragment injuries of the abdomen, both lower extremities and face. On surveying the patient the most outstanding signs were those of peritonitis but it was noted that there was no pulse in either foot and this was ascribed to shock which the patient undoubtedly had. Having no peripheral blood pressure, notwithstanding 1 L. of plasma before admission and 1 soon after, the patient was given 2 L. of whole blood following which he attained a blood pressure of 120/60.

As soon as the condition warranted and under bilateral field block of the abdomen a laparotomy was performed and four perforations of the jejunum were sutured, the subdiaphragmatic spaces irrigated and 4 Gm. of powdered sulfadiazine deposited therein before a layer closure, necessarily implemented by additional ether anesthesia. His postoperative condition was poor, blood pressure 90/40 and

At this time it was observed that the left foot was cooler than the right and the left foot could not be dorsiflexed even to 90 degrees, whereas the right, which showed equally as many penetrating and perforating wounds, could be so flexed. The patient had been given supportive treatment during the interval, including 2 L. more of blood. He was returned to the operating room and the left leg was opened liberally (fascia); the wounds in the upper part of the calf were débrided. During this process the posterior tibial artery was revealed completely transected very near its origin and thrombus had propagated proximally and partly involved the peroneal artery. Postoperatively there was a weak pulsation of the dorsalis pedis artery and repeated lumbar sympathetic blocks with 1 per cent procaine were done in an attempt to save the extremity. However, slowly progressing gangrene of the foot during the subsequent eight days eventually required mid-calf amputation.

CASE III. D. C. P., a captain, aged thirty-two, was admitted to the hospital with a history of having been struck in the left shoulder and right knee by "burp gun" slugs (.25 caliber, low velocity lead balls) twenty-four hours prior to admission. Examination showed severe shock, pulseless right foot and the plantar fixation sign positive. The patient

also had small wounds of the left shoulder, posterior chest, wounds above and below the right knee medially and laterally and a fracture of the left sixth rib but there was no evidence of intrathoracic injury. The patient was given general supportive measures, including 2,500 cc. of whole blood, and required several hours before he was considered suitable for operation. Examination of the right popliteal space under tourniquet showed a complete interruption of the popliteal artery and vein. The first part of the axillary artery was exposed for purpose of preventative hemostasis and a tape was passed beneath the vessel. Exposure of the third part of the axillary then showed a complete interruption of that vessel just distal to the origin of the subscapular artery. The axillary was also ligated, the several chest wounds were débrided and lumbar sympathetic block was done with procaine. The patient relapsed into shock with this latter procedure, his blood pressure falling to 65/50; but he responded to steep Trendelenburg position and an additional 1,000 cc. of whole blood. The upper extremity was asymptomatic and useful on the seventh postoperative day; it blanched on elevation only. The lower extremity gradually became gangrenous.

Case IV. W. F. S., a sergeant, aged twenty-seven, was admitted with a history of injury by multiple fragments of a mortar shell which burst at close range; duration of injury, sixteen hours. Examination showed marked shock and absence of pulsation in both feet although a blood pressure of 80/50 was obtained. The dorsiflexion sign was positive for the left foot and in addition there was apparent distention of the deep fascia of the calf on this side. As the shock was treated, the tension of the deep fascia increased and the foot was drawn spontaneously into plantar flexion from which it could not be elevated. The explanation for this unusual degree of swelling was brought out at operation. Extensive débridement of the lateral walls of the popliteal fossa (collaterals) was required in addition to ligation of the popliteal artery and vein. This extremity rapidly became gangrenous because of multiple injuries, several of which involved bone and because of severe infection superimposed upon the ischemia.

The following cases illustrate the utility of the sign in a negative sense. These cases in which the location of the injury and the peripheral signs strongly suggested main stem arterial occlusion but which did *not* demonstrate a plantar fixation sign were proved by operation to be severe vascular spasms arising from reflex stimulation.

Case V. J. F. L., an infantry private, aged twenty-seven, was admitted to the hospital with a perforating wound of the right thigh which had been caused by a large shell fragment twelve hours prior to admission. Immediately overlying the femoral artery in the lower portion of the femoral triangle was a large, ragged wound of entrance (3 cm. in diameter) and there was marked deep distention of the thigh, suggesting tension typical of interruption of a large vessel. In addition to these signs the foot was cool in contrast to the unaffected side and careful examination enlisted no pulse in the popliteal or smaller distal arteries. The dorsiflexion sign was negative. In view of the other signs, however, the patient was prepared as if for operation of an artery, including a large cannula in an arm vein and whole blood available in quantity. The patient was anesthetized and a heavy tourniquet was applied through the groin, utilizing Kirschner wires after the manner of the Wyeth pin. Complete dissection of the thigh showed numerous muscle arterial interruptions but examination of the femoral, profunda and even obturator arteries showed no damage to these vessels. The tourniquet was removed, the wound was débrided and hemostasis attended. There was weak pulsation in the femoral (very spastic) but still no pulsation in the peripheral arteries.

This patient was treated as if he had had major arterial interruption (with such facilities as were available) including repeated lumbar sympathetic blocks, whiskey, interdiction of tobacco, level leg and continuous oxygen for the first three days. After twenty-four hours weak pulses returned to a normal-looking foot and on the fifth day, oscillometric readings were only slightly reduced on the affected side as compared with the well leg.

Case VI. M. L. H., an infantry private, aged 19, was admitted to the hospital with a history of having been shot through both legs by a sniper twelve hours prior to admission. Examination showed the patient in moderate shock and with a most unusual injury in that a

single missile had entered the lateral aspect of the right popliteal fossa, traversed it and exited on the medial aspect. It then entered the left popliteal fossa at almost the identical level and exited this space, creating four small puncture wounds (two of entry and two of exit) and a moderate hematoma beneath the deep fascia in each situation. Both feet were cold and pulseless but the sign of plantar fixation was present on the right only.

After appropriate measures restoring the patient to an operable state the left popliteal fossa was investigated first and, as in a previous case, it was necessary to ligate only large muscle branches including the sural arteries. On the right, however, the popliteal had been transected in the upper part of its course and considerably more damage was done to other soft parts including the popliteal vein, the tibial nerve and the origins of both heads of the gastrocnemius muscle.

The patient's temperature soon rose to 103°F. and there was no difficulty deciding to which extremity to ascribe the cause of this elevation as the right foot and leg became gangrenous, whereas the left promptly recovered its vascular balance.

CONCLUSION

A new diagnostic sign with which one is apparently capable of differentiating acute arterial interruption in the lower extremity from vascular spasm is offered. Cases are cited, both positive and negative, to demonstrate the utility of this sign.

ACCORDING to E. I. Lowenberg, if emboli in the large arteries are removed within the first ten hours, amputation may be avoided. Paravertebral novocain block of the related sympathetics and intravenous injections of papaverine hydrochloride (½ gr.) help to overcome the associated vasospasm. Anticoagulant therapy also plays an important part and must be continued after embolectomy to prevent the postoperative occurrence of secondary thrombosis. Postoperative sympathetic block also must be continued for the same reason. Instead of using local novocain injections, a similar effect can be produced by intravenous or intramuscular injections of tetraethylammonium bromide. Medical regimen alone may be indicated when only a smaller artery is involved or when the embolus has been present for over ten hours. Refrigeration anesthesia can be used if amputation becomes inevitable. (*Richard A. Leonardo, M.D.*)

New Instrument

A NEW SELF-RETAINING RETRACTOR*

FRANCIS A. BENEVENTI, M.D.
New York, New York

OUR purpose in designing this retractor was to construct an instrument which would meet the needs of both abdominal and genitourinary surgeons.

The retractor has three removable retracting blades which are adjustable so that the one instrument can be used for (1) open operations on the urinary bladder, (2) exposure of the prevesical structures, (3) operations on the lower ureter and (4) other abdominal procedures which require deep retraction. The difficulty encountered in retracting the wound edges in obese patients is overcome to a great extent by a simple screw adjustment of the lateral blades; this can extend the depth of the blades up to an added ¾ inch. Figures 1 and 2 show the architecture of the instrument as viewed from above (surgeon's eye view) and laterally.

The retractor is sturdily built along the simplest lines and uses the most suitable angles for greater retraction. Its three blades are adjustable, reversible and removable so as to give the instrument the maximum versatility and thereby make it a useful device for as many types of abdominal operations as possible rather than for one particular procedure. The surgeon needs only one retractor boiled for operation and still will be able to cope with any surgical eventuality that may present itself. The necessity of boiling several retractors is thereby eliminated.

The lateral blades of the retractor are not only adjustable for depth but are also reversible so that their convex or concave surfaces can be made to curve inward or outward to meet the needs of the surgeon. Figure 3 shows the versatility of the lateral blades in operations involving the urinary bladder in which it has usually been necessary to enlist the aid of an extra assistant for purposes of retracting the bladder walls. In the drawing, the blades are set so that their concave surfaces present into the bladder. This position of the blades allows a larger operative field. The bladder walls remain in the desired position and it is not necessary to place a fixing suture from the edge of the bladder to the rectus fascia. After the incision in the bladder has been made, the cut edges of the wall are grasped with Allis clamps and held apart to permit entrance of the lateral blades. The retractor is then held at an angle so that only one blade at a time is inserted into the bladder lumen. After entry of the first blade the hand screw is tightened to keep the blade in position; the retractor is then leveled off and the untightened remaining lateral blade is inserted into the bladder and the screw set. The retractor is then ready for use.

In retropubic prostatectomy, in which exposure of the anterior surface of the prostatic capsule with its adjacent vessels and a good, unimpaired view of the prostatovesical junction are imperative, the retractor is especially useful. Figures 4 and 5 show the instrument in the proper position for such an operation; here the lateral blades are shown adjusted so that their convex surfaces present in the wound. They are also set for maximum depth.

Figure 4 clearly shows the need for deep

* From the Department of Urology (James Buchanan Brady Foundation) of the New York Hospital, New York, N. Y.

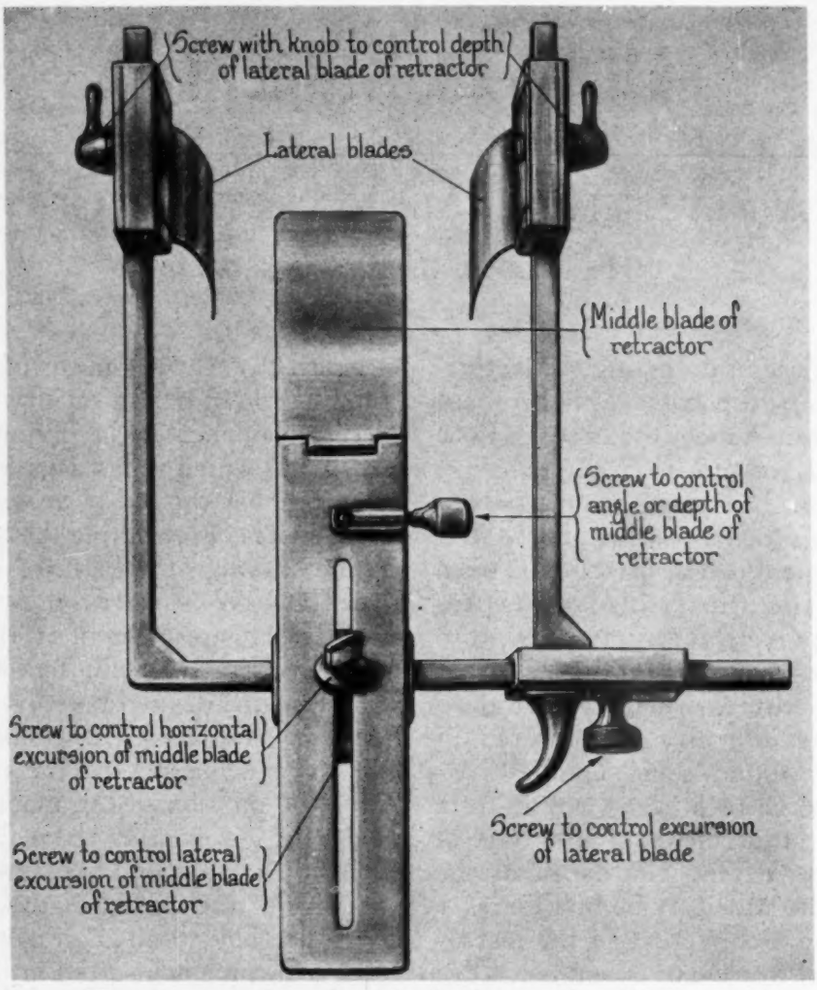

Screw with knob to control depth of lateral blade of retractor
Lateral blades
Middle blade of retractor
Screw to control angle or depth of middle blade of retractor
Screw to control horizontal excursion of middle blade of retractor
Screw to control lateral excursion of middle blade of retractor
Screw to control excursion of lateral blade

FIG. 1. View of retractor from above showing framework and blades in position. The lateral blades are reversible, concave or convex and adjustable for depth.

and constant retraction in retropubic surgery. This drawing beautifully illustrates the position of the lateral blades and their relation to the lateral plexus of veins. The tips of the blades are in the lateral prostatovesical recesses, thereby exposing as much as possible of the anterior and upper lateral surfaces of the prostatic capsule and the plexus. A transverse incision has been made in the anterior capsule down to the adenoma. The relation of the prostatovesical junction to the incision is clearly outlined. For the sake of clarity the three preliminary hemostatic and retention sutures generally placed in the anterior prostatic capsule prior to incision of the capsule have purposely been omitted in the drawing. Access to the lateral recesses of the bladder is easily obtained after careful hand and stick-sponge retraction of the retropubic fat. Beneventi and Twinem* have stressed the importance of exercising care in this dissection so as not to open the large plexus of veins which hugs the lateral walls of the prostate and bladder. Gauze sponges may or may not be used as traps for spilled blood in the lateral recesses, depending on the surgeon's preference. The blades of the retractor are rounded, smooth and blunt; and the bare blades have never, in our experience, been known to damage any of the neighboring structures.

In performing suprapubic or retropubic

* BENEVENTI, F. A. and TWINEM, F. P. Experiences with retropubic prostatectomy. *New York State J. Med.*, 49: 623–628, 1949.

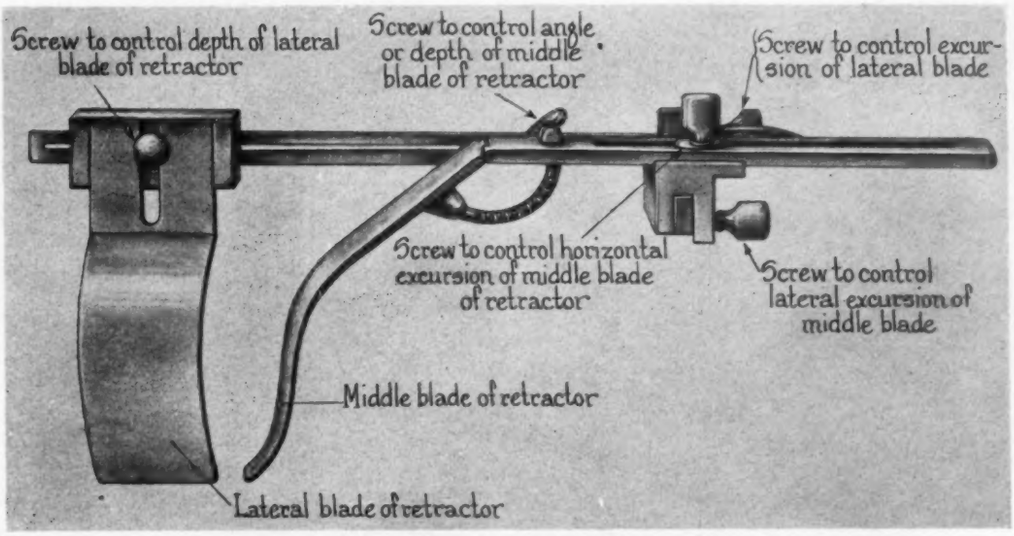

Screw to control depth of lateral blade of retractor
Screw to control angle or depth of middle blade of retractor
Screw to control excursion of lateral blade
Screw to control horizontal excursion of middle blade of retractor
Screw to control lateral excursion of middle blade
Middle blade of retractor
Lateral blade of retractor

FIG. 2. Lateral view of retractor.

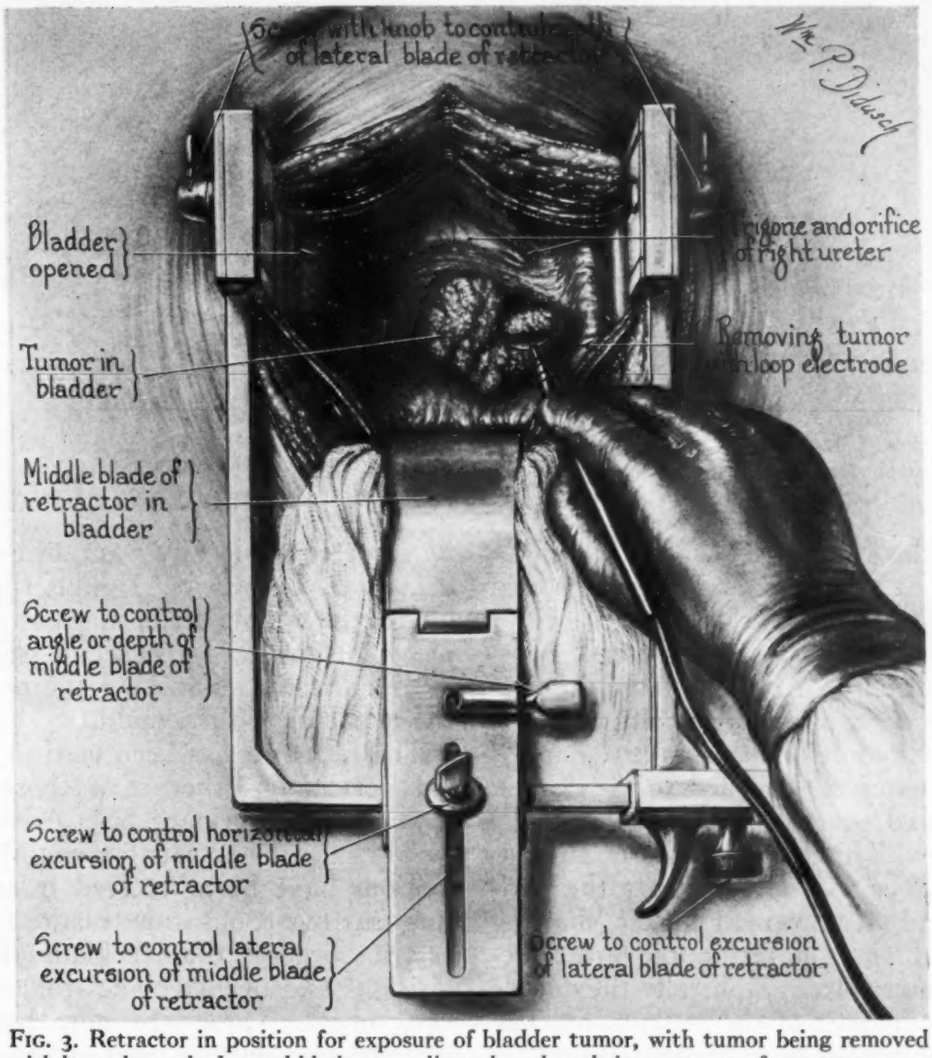

Wm. P. Didusch
Bladder opened
Tumor in bladder
Middle blade of retractor in bladder
Screw to control angle or depth of middle blade of retractor
Screw to control horizontal excursion of middle blade of retractor
Screw to control lateral excursion of middle blade of retractor
Screw to control excursion of lateral blade of retractor

FIG. 3. Retractor in position for exposure of bladder tumor, with tumor being removed with loop electrode. Lateral blades are adjusted so that their concave surfaces are present in the wound. Medium arm is adjusted for anterior retraction.

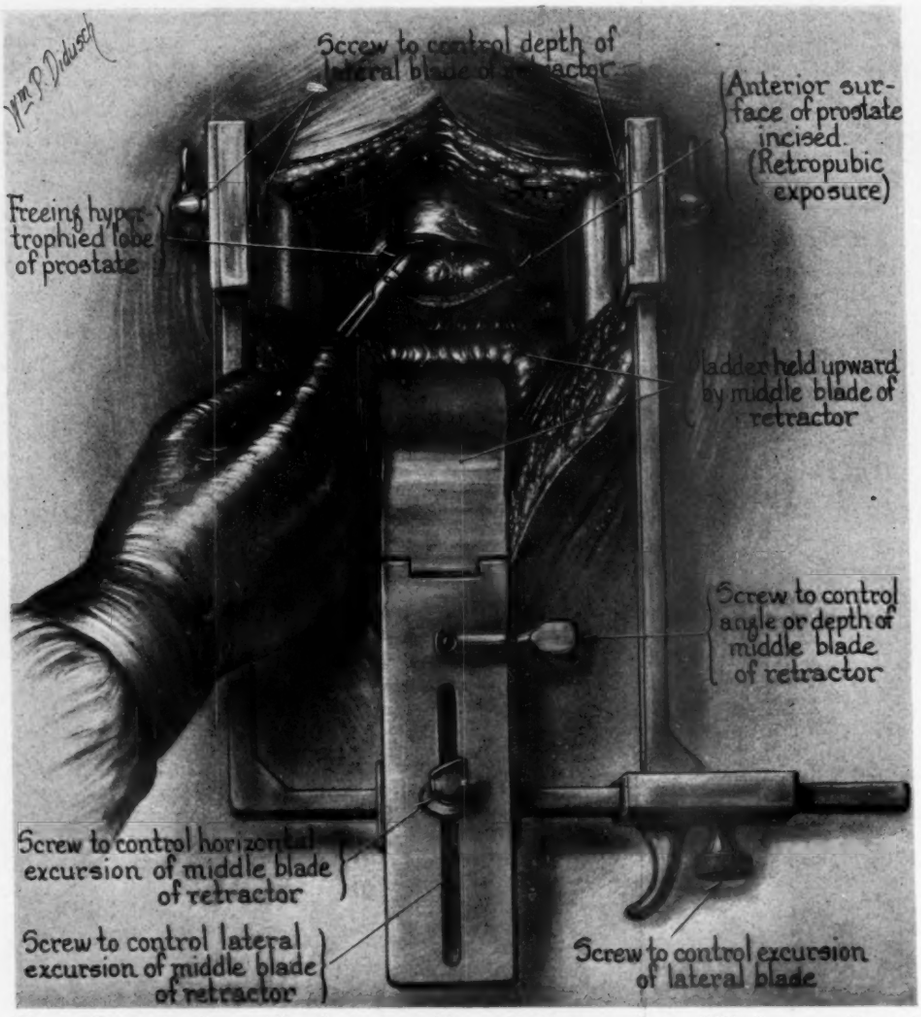

Wm. P. Didusch
Screw to control depth of lateral blade of retractor
Anterior surface of prostate incised. (Retropubic exposure)
Freeing hypertrophied lobe of prostate
Bladder held upward by middle blade of retractor
Screw to control angle or depth of middle blade of retractor
Screw to control horizontal excursion of middle blade of retractor
Screw to control lateral excursion of middle blade of retractor
Screw to control excursion of lateral blade

FIG. 4. Retractor in position for retropubic prostatectomy. Lateral blades are adjusted in this case so that their convex surfaces are present in the wound. Middle blade retracts and depresses fundus of bladder.

surgery, the cross piece of the retractor should lie at the upper angle of the wound and the lateral blades should be placed at the most distal part of the lateral arms. (Figs. 3, 4 and 5.) After the lateral retractors have been placed in position in the wound the middle blade is simply snapped on the cross piece, adjusted to the desired position and securely fastened with the hand screw. This blade depresses the anterior bladder wall and retracts the peritoneum and fat upward. Figure 5, showing a sectional view in retropubic prostatectomy, demonstrates graphically the double action of this part of the instrument. The hinge-joint action is extremely gentle on the retracted tissue, yet it is firm and can be securely set in any position by the aid of two hand screws. Unlike the lateral blades the middle blade snaps on the cross piece so that it can be set in place or removed without disturbing the position of the retractor in the wound.

The retractor has been used in abdominal operations other than those dealing with the genitourinary tract, with a great deal of success and satisfaction. Many suggestions have been received from general surgeons regarding wider blades for use in gastric surgery, thinner blades for small incisions and deeper blades for use in the very obese. These are now being constructed and will be used as interchangeable parts.

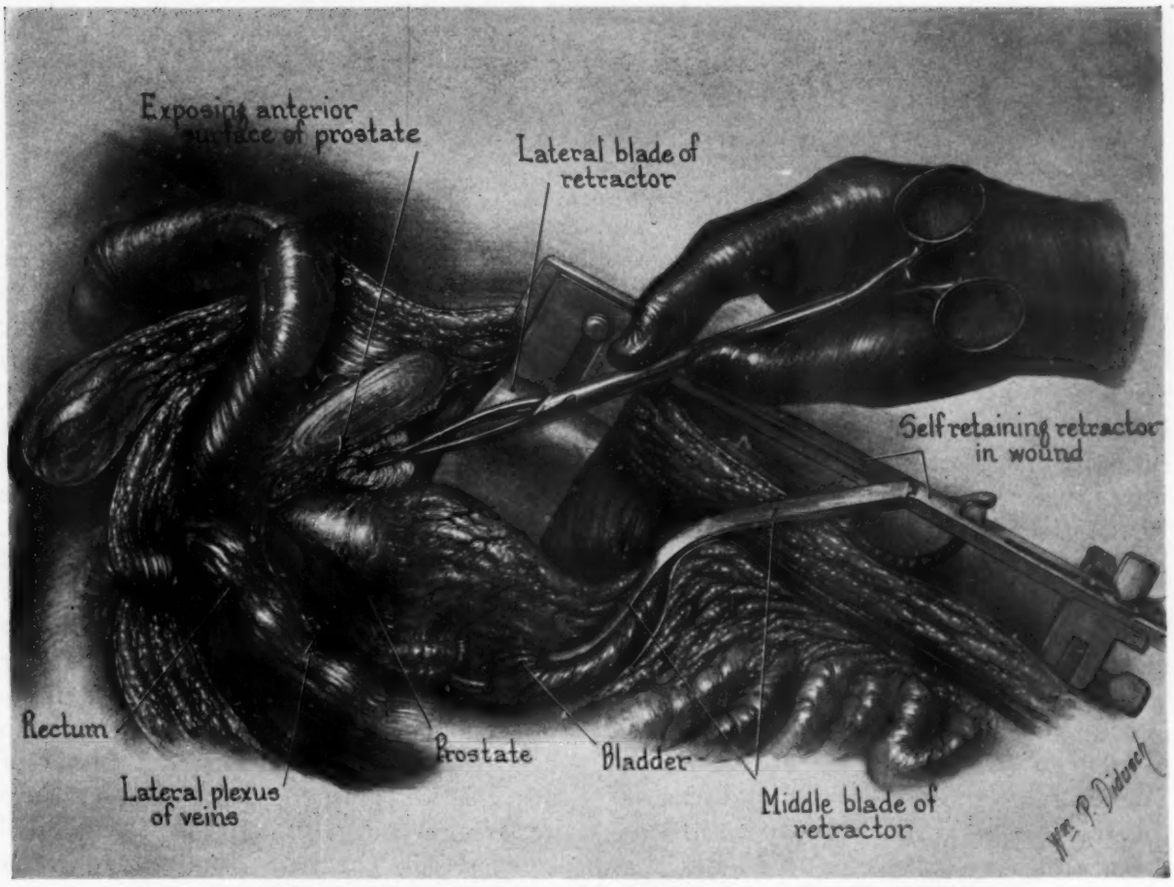


FIG. 5. Retractor in position for retropubic prostatectomy; sectional view.

The frame of the retractor is best described as an open-end square with each arm 8 inches long. At present, the retracting blades are 1½ inches wide and made to curve for maximum versatility and exposure. The instrument is soundly constructed and has sufficient weight to keep it from popping out of the wound during operation. It is designed to withstand the strong pressures exerted on the wound margins in obtaining surgical exposure in deep abdominal wounds, without disturbing the position of the retractor.

We wish to acknowledge the valuable suggestions of Mr. Frederick J. Wallace, of American Cystoscope Makers, Inc., New York, N. Y., in the construction of this new instrument, and the suggestions and splendid illustrations of Mr. William P. Didusch, of Baltimore, Md.

COLUMBIA UNIVERSITY
COLLEGE OF PHYSICIANS AND SURGEONS

New York

FOUNDED in 1754 by a royal grant of George II, King of England, "for the instruction of Youth in the Learned Languages, and the Liberal Arts and Sciences," Columbia College began as King's College. Its program was interrupted by the Revolutionary War, but in 1784 it was re-opened as Columbia College. In 1912 the title was changed to Columbia University in the City of New York.

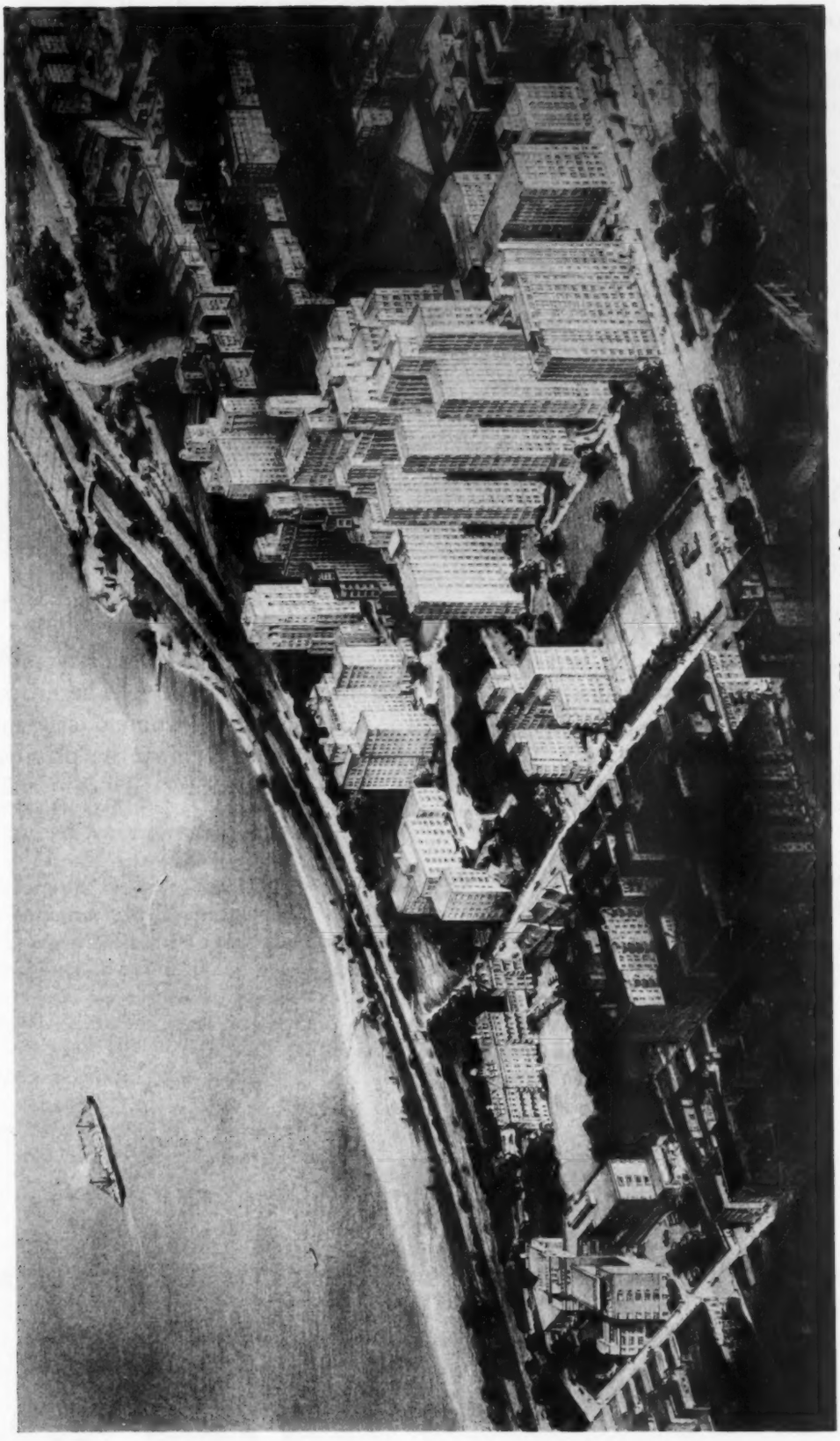
A medical faculty was organized at King's College in 1767. It was the first institution in the North American Colonies to confer the degree of Doctor of Medicine in course. The first individuals to graduate in medicine from the College were Robert Tucker and Samuel Kissam, who received the degree of Bachelor of Medicine in May, 1769, and that of Doctor of Medicine in May, 1770 and May, 1771, respectively. Instruction in medicine was continued until the War of the Revolution. In 1784 an act was passed making Columbia College in the City of New York the successor of King's College, and instruction was resumed in the academic department. The medical faculty was reëstablished eight years later. In 1814 the medical faculty of Columbia College was merged with the College of Physicians and Surgeons which had obtained an independent charter in 1807. By agreement between the trustees of the two institutions in 1860 the College of Physicians and Surgeons became the medical department of Columbia College. From that time on the diplomas of the graduates were signed by the President of Columbia College as well as by the President of the College of Physicians and Surgeons. The connection was only a nominal one, however, until 1891 when the College was incorporated as an integral part of the University.

In 1945 the Medical Faculty was made responsible for the educational program in Medicine, Dental and Oral Surgery, Public Health and Nursing, and Associate Deans were named to each of these divisions.

In medicine the minimum requirement for admission to the first year class is attendance for three full academic years at an approved college of arts and sciences. Preference is given in the selection of students to those who, in the opinion of the Committee on Admissions, present evidence of high achievement in their college education and who are most likely to succeed in medicine, rather than to those who present the largest number of course credits or who have limited their preparation largely to the premedical sciences. Of the one hundred fourteen students who entered the medical school in 1947 seventy-two were discharged veterans. Since September, 1917, women have been admitted to the school on the same basis as men.

The School of Public Health is part of the Medical Faculty of Columbia University and shares in the research and teaching resources of the Columbia-Presbyterian Medical Center and of the affiliated hospitals and clinics.

The School of Tropical Medicine of the University of Puerto Rico, under the auspices of Columbia University, is maintained in part by the government of Puerto Rico and in part by Columbia University. The latter directs the educational policy and nominates the teaching and research staff, subject to the approval of the Special Board of Trustees. The courses at the Columbia University School of Public Health are so arranged that a student in public health or tropical medicine may for the first two quarters absolve



Columbia University College of Physicians and Surgeons

May, 1949

the school's requirements as to basic courses and in the third and fourth quarters pursue elective studies in a tropical environment at the Puerto Rico School of Tropical Medicine. In the Virgin Islands the school maintains clinical and research studies. The Faculty of Medicine offers a program of study leading to a Bachelor of Science degree in Physical Therapy and in Occupational Therapy.

In January, 1944, all the voluntary hospitals and clinics at the Medical Center were consolidated into a single corporation under the Presbyterian Hospital. The several hospitals continue to function as separate units of the Presbyterian Hospital. The Medical Center group is as follows: The College of Physicians and Surgeons, School of Dental and Oral Surgery, School of Nursing, School of Public Health, Washington Heights Health and Teaching Center, New York State Psychiatric Institute; the Presbyterian Hospital and its subdivisions: the Squier Urological Clinic, the Institute of Ophthalmology, Harkness Pavilion, Sloane Hospital for Women, Vanderbilt Clinic, Babies Hospital, Neurological Institute, the New York Orthopedic Dispensary and Hospital and the Mary Harkness Convalescent Home.

Other hospitals used for teaching purposes are Bellevue Hospital, Goldwater Memorial Hospital, Hospital for Joint Diseases, Hospital for Special Surgery, Institute for the Crippled and Disabled, Margaret Hague Maternity Hospital (a unit of the Jersey City Medical Center), Mary Imogene Bassett Hospital, Cooperstown, N. Y., Montefiore Hospital for Chronic Diseases, Morrisania Hospital, Mount Sinai Hospital, Roosevelt Hospital, St. Luke's Hospital, Willard Parker Hospital and Woman's Hospital.

Bard Hall, the residence for students of the Medical School, is located on the property of the Medical Center. It is a building of eleven stories with three additional stories in the north wing and it occupies a site overlooking Riverside Drive and the Hudson River. There are rooms to accommodate women students. All medical students enjoy the privileges and facilities of the University campus.

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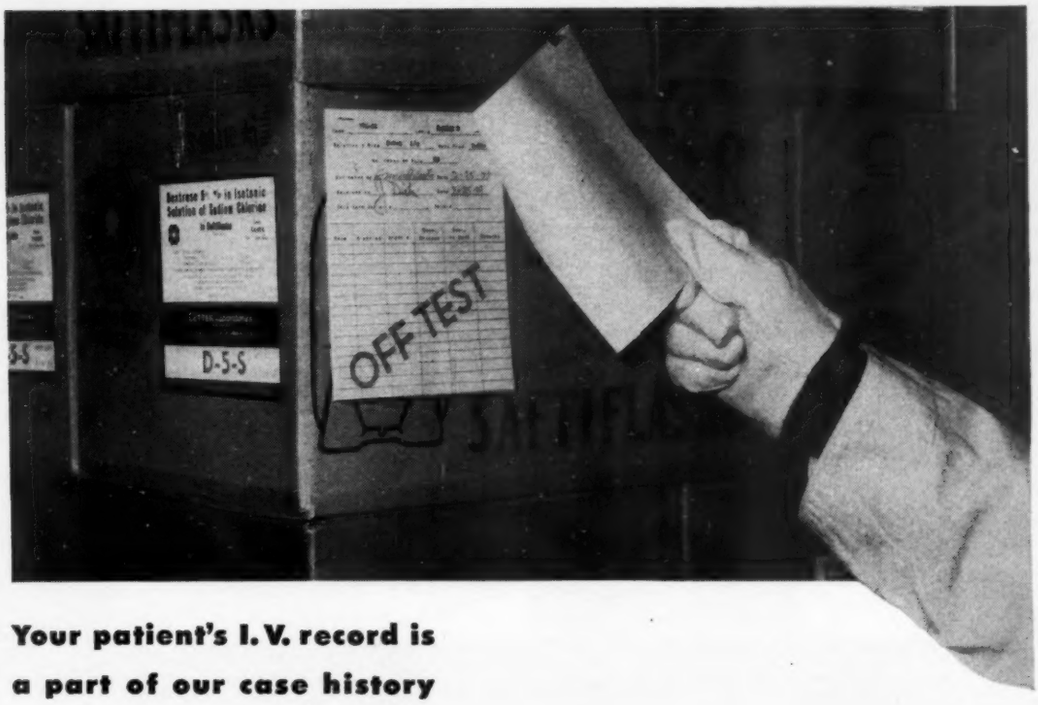

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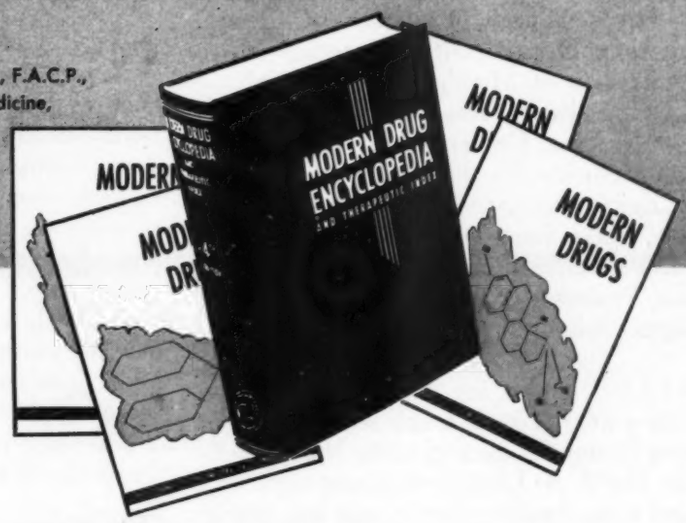

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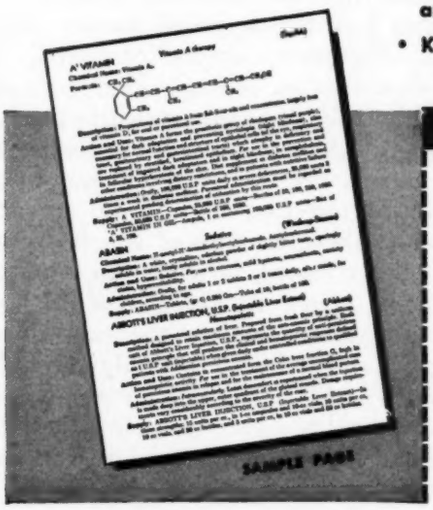

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Outside the Ivory Tower

(*continued from page 28*)

ments which were televised in cooperation with RCA from the firm's Pharmacology Laboratories on the fifth floor down to the meeting hall on the first floor.

Overweight, another serious medical problem which physicians treating the aged encounter, was the subject of another panel discussion. The chairman of this panel was Dr. Andrew C. Ivy, Vice-president in charge of the Chicago Professional Colleges of the University of Illinois. Other members of this panel were: Dr. L. H. Newburgh, Professor of Clinical Investigation, Department of Internal Medicine, University of Michigan Medical School; Dr. Edward Rose, Associate Professor of Clinical Medicine, University of Pennsylvania School of Medicine; Dr. Edward H. Rynearson, Mayo Clinic, Associate Professor of Internal Medicine, Mayo Foundation Graduate School, University of Minnesota and Dr. Robert H. Williams, Professor of Medicine, University of Washington School of Medicine.

CERTAIN books are truly outstanding. Such a work, now in a new second edition, is Sterling Bunnell's, *Surgery of the Hand*, (published by the J. B. Lippincott Company). It's 930 pages long, double column, and has nearly eight hundred illustrations, many of which are in color. The first edition was excellent and this edition has the quality of the first, but considerable new material has been added in chapters on Reconstruction, Injuries, Infections and Tumors to name only a few. The current application of chemotherapy and antibiotics is included. The work demonstrates that as a result of the recent war the hands should be treated as an entity and not passed from one tissue specialist to another. We believe that every surgeon accepting problems of surgery of the hand should give this work thought and study. It is an ideal gift for an intern, resident or young practitioner in surgery, the price of which is $16.

IN the past year I have had an opportunity to observe the rapidity of healing not too deep bed sores. Sodium alkyl sulfate (2 per cent) in a base of hydrosorb was applied morning and evening. This was based upon the evidence that experimentally-produced superficial wounds healed in one-half the time when 2 per cent alkyl sulfate was continuously applied if compared to controlled superficial wounds without its application. Apparently this rapidity of healing must have been intradependent upon the binding of enzymes. It may be possible that the continued breakdown of the skin and associated bed sores is also the result of tissue enzymes. I am merely passing this on because I think bed sores are so common and they are so refractory to treatment. (From a letter by Dr. S. A. Portis.)

NINETEEN forty-eight set a new low record for mortality, according to the experience among the many millions of Industrial policyholders of the Metropolitan Life Insurance Company in the United States and Canada. Last year was the fifth in succession to show an improvement in mortality (exclusive of enemy action). The death rate for the year was 6.5 per 1,000 policyholders, as compared with 6.6 in 1947, the previous low. The new minimum in 1948 was reached despite the high incidence of respiratory diseases in the early weeks of the year and the heat spell of late summer, each of which resulted in a sharp rise in the number of deaths.

TEN thousand atom bombs could be made from known deposits of fissionable elements, Professor J. A. Campbell of Oberlin College asserted at a meeting of the Erie Section of the American Chemical Society.

"In spite of all the supposed secrecy about the bomb," Professor Campbell declared, "it is easy to show that the explosive charge weighs in the neighborhood of twenty to thirty pounds and occupies a sphere of three or four inches in diameter—about the size of an indoor baseball." Pointing out that there is no scarcity of uranium or thorium, both of which can be made to undergo fission, he said: "In terms of atomic bombs, there is enough material in sight to fabricate at least ten thousand. New mines are being discovered monthly throughout the world. Any country with a considerable land area is bound to have available to it sufficient stocks of fissionable material at least for bomb production."

THE American Red Cross, after a series of three successful experimental studies, has authorized the training of carefully selected

(*continued on page 38*)

Coming!

IN NOVEMBER

SYMPOSIUM ON

DIABETES

Guest Editor

Russell Wilder, M.D.

MAYO CLINIC
ROCHESTER, MINN.

Outside the Ivory Tower

(*continued from page 36*)

non-nurses as instructors of the basic home nursing course, *Care of the Sick*, in communities where there is an insufficient number of nurse instructors. In broadening policy to extend the Red Cross Home Nursing Program into communities where there are fewer nurses and where instruction may be most needed the organization is also "upgrading" professional nurse instructors to the status of teacher-trainers or of instructors of home nursing classes that present special problems.

WHERE is it? $10,200,800,000 has been paid into the Social Security Administration in eleven years and $849,000,000 collected in interest. Benefits paid a total of $1,689,600,000 and administrative costs of $246,000,000. The kitty remaining is over nine billion. Where do you suppose it is? (From the News Letter, American Medical Association, April 8, 1948.)

THE Army desires 6,900 medical officers, and for the first time in its history also wants 1,300 recent graduates for interns and residents. It believes that without this force it cannot provide the medical care demanded in the 1948 Selective Service Act. There are about 180,000 doctors, including interns, in active practice to provide for 142,000,000 people. This includes the insane, aged, crippled and chronically ill, infants, children, women in childbirth, those injured in industry, by automobiles or accident. There is one doctor for every 780 civilian patients; the Army wants one doctor for every 165 men, selected for sound bodies and sane minds, living at peace, in quarters and on diets which are far better than the average civilian has. (From a letter by Wm. Dock, M.D., *The N. Y. Times.*)

SMITH, Kline & French Laboratories of Philadelphia awarded in 1948 a total of seventy-three grants amounting to $314,761 in support of medical research, according to an announcement by Mr. W. Furness Thompson, Vice-President in charge of research. Twenty-seven of these grants were made to twenty medical schools and the balance to institutes, clinics and individual investigators.

ATTENTION of readers of *The N. Y. State Journal of Medicine* is directed to careful study of the twelve resolutions adopted at the General Assembly in Geneva, September 8 to 11, 1948, of the World Medical Association.* These call for:

(1) Freedom of choice of a physician by the patient. Liberty of the physician to choose the patient except in cases of urgency or humanitarianism. (2) No intervention of a third party between the physician and patient. (3) When medical service is to be submitted to control, this control should be exercised by physicians. (4) Freedom of choice of a hospital by the patient. (5) Freedom of the physician to choose the location and type of his practice. (6) No restriction of medication or mode of treatment by the physician except in case of abuse. (7) Appropriate representation of the medical profession in every body (official) dealing with medical care. (8) It is not in the public interest that physicians should be full-time salaried servants of the government or social security bodies. (9) Remuneration of medical services ought not to depend directly on the financial condition of the insurance organization. (10) Any social security or insurance plan must be open to the participation of any licensed physician, and no physician should be compelled to participate if he does not wish to do so. (11) Compulsory health insurance plans should cover only those persons who are unable to make their own arrangements for medical care. (12) There shall be no exploitation of the physician, the physician's services or the public by any person or organization.

WE have noted that the great majority of "big names" in medicine who favor socialized medicine are full-time workers. For the most part these gentlemen have never practiced their calling. It would be interesting to hear from the "big names" in our profession who are engaged in private practice, who swim against the tide, deal first hand with the public and who by their efforts and skill make a living by actually treating the sick and maimed. We wonder how many of these men would welcome the proposed new order of free medical care under government control.

* *J.A.M.A.* 138: 436, 1948.

Important

IN POSTOPERATIVE CONVALESCENCE

The initial recovery response to surgical trauma stems largely from the preoperative nutritional state of the patient. Continuation of that response is largely the burden of the postoperative diet. Since the tolerance for food, however, is frequently limited in surgical convalescence, a food supplement is highly valuable for increasing the intake of essential nutrients.

The *multiple dietary supplement* Ovaltine in milk is particularly useful for supplementing the dietary following surgery. Its liberal content of vitamins and minerals and its protein of high biologic value readily supplement restricted diets to adequacy. Patients are refreshed by its pleasing flavor and food energy. The easy digestibility also adapts this valuable supplementary food to the convalescent's needs.

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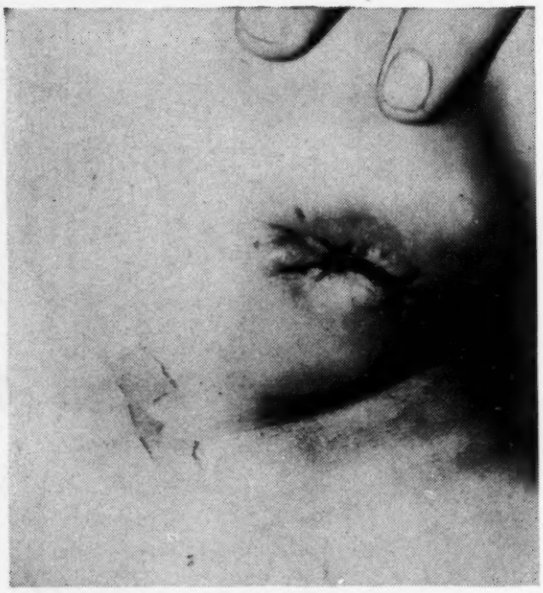
CARBOHYDRATE	65 Gm.	NIACIN	6.8 mg.
CALCIUM	1.12 Gm.	VITAMIN C	30.0 mg.
PHOSPHORUS	0.94 Gm.	VITAMIN D	417 I.U.
IRON	12 mg.	COPPER	0.5 mg.

***Based on average reported values for milk.**

Two kinds, Plain and Chocolate Flavored. Serving for serving, they are virtually identical in nutritional content.

Decubitus ulcer of 6 months' duration on left buttock of paraplegic. Photo above shows appearance after 2nd attempt at surgical closure. Base of ulcer was dirty and foul smelling.



Cleaning-up with Chloresium Solution was followed by daily dressing with Chloresium Ointment. The area was completely healed in 21 days. There has been no recurrence in 6 months.

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*Boehme, E. J.	The Treatment of Chronic Leg Ulcers	The Lahey Clinic Bulletin, 4:242 (1946)
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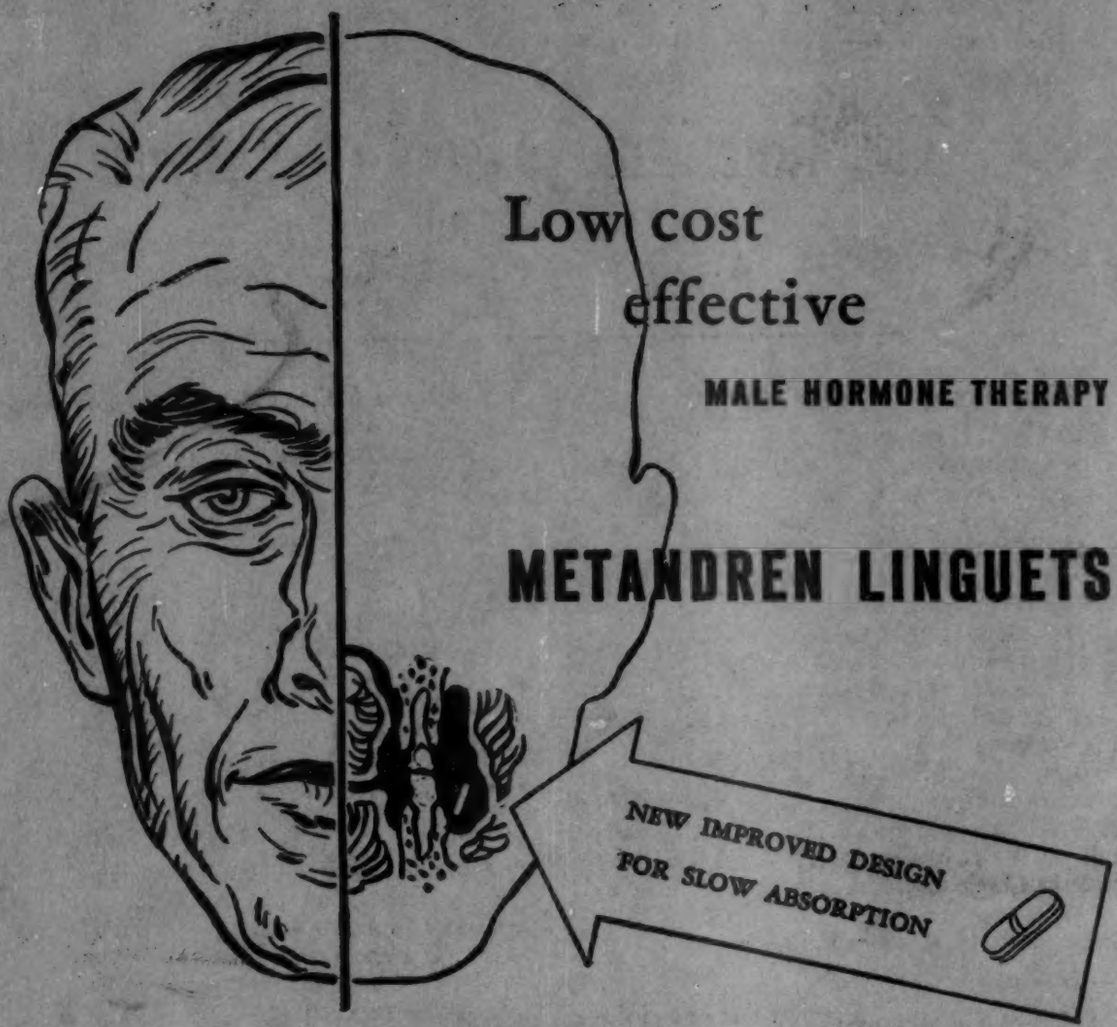

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• *Literature on request.*

1. Habel, J. M., Jr.: Va. Med. Monthly, October 1948.

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